THE LABORATORY:

A WEEKLY RECORD

OF

SCIENTIFIC RESEARCH.

1867.

APRIL TO OCTOBER.

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WITH much regret I announce the cessation of the publication of THE LABORATORY at the close of the present volume.

Though the circulation of the Journal has been increasing week by week it is still too limited to justify the proprietors incurring further expenses. They have therefore decided to abandon the undertaking; and many circumstances concur to prevent my carrying on the Journal on my own responsibility.

Though the attempt to establish a weekly medium of publication and intercommunication for chemists and physicists has failed for want of adequate support, the articles printed in this volume prove that THE LABORATORY supplied a want in scientific periodical literature. The names of many of the leading chemists of Europe are appended to the Original Communications, which have been forwarded to me, and most of the articles which have appeared without signature have been contributed by writers of scientific and literary eminence. There has been no lack of help in the Editorial department of the Journal, but it would seem that the number of persons interested in pure science is too limited to support such a journal as THE LABORATORY, conducted on ordinary commercial principles.

I trust, however, that THE LABORATORY will re-appear, though perhaps in another form, at the commencement of the next year, and that I am merely taking leave of its readers for a short time. I retain the copyright, and shall spare no pains to insure the re-appearance of THE LABORATORY at a future date.

It is satisfactory to think that, although the Journal has been brought somewhat suddenly to a close, the volume contains scarcely any incomplete papers. Mr. Quin's Special Report on the Paris Universal Exhibition terminates with the volume, and the last communication from Dr. Matthiessen, and Mr. Hockin completes the first three sections of their work, namely, Specific Gravity, Expansion by Heat, and Electrical Resistance.

I cannot conclude this valedictory note without expressing my hearty thanks to those gentlemen whose active help and good counsel have so materially assisted in the realisation of my idea of a worthy record of scientific research.

JOHN CARGILL BROUGH.

Stockwell, Sept. 26, 1867.

2 nov 1867. Dec. 9.

Gratis. Sci 1004

THE LABORATORY:

A Weekly Record of Scientific Research.

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CONTENTS.

THE LABORATORY:

A Weekly Record of Scientific Research.

Price Sixpence.

In France and Germany the original researches of chemists and physicists are faithfully reflected by an independent scientific press, but it is generally admitted that the important work performed in the public and private laboratories of the United Kingdom is inadequately represented by existing journals. Hence, those minor and tentative investigations that are often so suggestive, but which are not of sufficient importance to be brought before the learned societies, are rarely recorded. To provide the numerous workers in the field of Experimental Research with a convenient MEDIUM OF INTERCOMMUNICATION is the aim of the projectors of *The Laboratory*. At the present juncture of chemical history, when new theories and new systems of notation are absorbing so much attention, the want of such a medium is keenly felt.

ORIGINAL COMMUNICATIONS will form the staple contents of *The Laboratory*, and no pains will be spared to obtain papers that must attract the attention of the scientific world. Many eminent chemists and physicists have already promised to write articles for the early numbers, and the principles upon which the journal is to be conducted cannot fail to give satisfaction to contributors.

Short EDITORIAL ARTICLES upon topics which specially concern scientific men will appear in each number, and it is hoped that by the aid of these articles *The Laboratory* will become an important organ of opinion. The ignorance frequently displayed by ordinary journalists when they attempt to elucidate subjects pertaining to chemistry or physics, the current errors of popular science, the occasional violation of professional ethics by well-known analysts, and the charlatanry which is too often accepted as evidence of high scientific attainments—prove that the periodical press may be profitably strengthened by the publication of a thoroughly independent scientific journal.

The PROCEEDINGS OF SOCIETIES will be specially reported for *The Laboratory*, and no time will be lost in preparing the reports for the press.

All NEW BOOKS relating to Chemistry and the various branches of Physical Science will be carefully noticed, and those which are most worthy of attention will be minutely, fairly, and fearlessly reviewed.

Though *The Laboratory* will be mainly devoted to British research, a considerable portion of each number will be allotted to FOREIGN SCIENCE. Arrangements have been made for obtaining early notices of the proceedings of the principal learned bodies of France, Belgium, and Germany, together with abstracts of contributions to the Continental scientific press.

TERMS OF SUBSCRIPTION:—*The Laboratory* will be regularly forwarded direct from the Office to any address within the United Kingdom at the following rates, payable in advance:

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*** All Communications relating to the Editorial Department should be addressed to THE EDITOR, 4, Norman Terrace, Stockwell, London, S.; but all letters relating to Advertisements, Subscriptions, and General Business Arrangements, to the Publisher, JAMES FIRTH, 41a, Cannon Street, London, E.C.

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ON CHEMISTRY AND PHARMACY.

By Professor REDWOOD.

ON BOTANY AND MATERIA MEDICA.

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ORIGINAL COMMUNICATIONS.

DR. MATTHIESSEN ON ALLOYS.

On Alloys. By A. Matthiessen, *F.R.S., Lecturer on Chemistry at St. Mary's Hospital Medical School.*

1. *On the Determination of Specific Gravity.**

E is the most convenient formula to use when the following tables are employed to find log $\sigma_{t,r}$, and log ρ_t.

Table I.

Specific gravity of air at different temperatures.

$$Log,\ \sigma_t = log\ \frac{0{\cdot}001293}{1 + 0{\cdot}003656_t}.$$

0° =	$\bar{3}$·1115985	16 =	$\bar{3}$·0869093
1 =	$\bar{3}$·1100136	17 =	$\bar{3}$·0854119
2 =	$\bar{3}$·1084345	18 =	$\bar{3}$·0839195
3 =	$\bar{3}$·1068611	19 =	$\bar{3}$·0824323
4 =	$\bar{3}$·1052934	20 =	$\bar{3}$·0809502
5 =	$\bar{3}$·1037313	21 =	$\bar{3}$·0794732
6 =	$\bar{3}$·1021748	22 =	$\bar{3}$·0780011
7 =	$\bar{3}$·1006239	23 =	$\bar{3}$·0765339
8 =	$\bar{3}$·0990785	24 =	$\bar{3}$·0750718
9 =	$\bar{3}$·0975385	25 =	$\bar{3}$·0736146
10 =	$\bar{3}$·0960041	26 =	$\bar{3}$·0721620
11 =	$\bar{3}$·0944750	27 =	$\bar{3}$·0707146
12 =	$\bar{3}$·0929513	28 =	$\bar{3}$·0692719
13 =	$\bar{3}$·0914329	29 =	$\bar{3}$·0678340
14 =	$\bar{3}$·0899198	30 =	$\bar{3}$·0664005
15 =	$\bar{3}$·0884119		

The reason why the coefficient of expansion of air is taken as 0·003656 is, that Miller in his paper "On the Construction of the new Standard Pound" ('Phil. Trans.,' 1856, p. 714) points out the following fact:—"Regnault found the expansion of air from 0° to 100° under constant pressure equal to 0·36706 of its volume at 0°. . . The difference between the mercurial and air thermometers at 50° amounts to about 0°.2. Hence the expansion of air between 0° and 50°.2 is 0·18353 of its volume at 0°; or between 0° and 50° the ratio of the density of air at 0° to its density at *t* is $1 + 0{\cdot}003656 \times t$."

* Continued from p. 3.

Table II.

Specific gravity of water at different temperatures.

Log, ρ_t.

4° =	0·00000	18 =	$\bar{1}$·9993872
5 =	$\bar{1}$·9999974	19 =	$\bar{1}$·9993022
6 =	$\bar{1}$·9999878	20 =	$\bar{1}$·9992129
7 =	$\bar{1}$·9999714	21 =	$\bar{1}$,9991197
8 =	$\bar{1}$·9999483	22 =	$\bar{1}$·9990222
9 =	$\bar{1}$·9999179	23 =	$\bar{1}$·9989208
10 =	$\bar{1}$·9998823	24 =	$\bar{1}$·9988156
11 =	$\bar{1}$·9998398	25 =	$\bar{1}$·9987068
12 =	$\bar{1}$·9997920	26 =	$\bar{1}$·9985948
13 =	$\bar{1}$·9997378	27 =	$\bar{1}$·9984796
14 =	$\bar{1}$·9996779	28 =	$\bar{1}$·9983615
15 =	$\bar{1}$·9996128	29 =	$\bar{1}$·9982408
16 =	$\bar{1}$·9995425	30 =	$\bar{1}$·9981175
17 =	$\bar{1}$·9994675		

Table III.

To reduce to 0° C. the readings of a barometer with glass scale.

	MM. 720	MM. 740	MM. 760	MM. 780
1°	0·12	0·13	0·13	0·13
2	0·25	0·25	0·26	0·27
3	0·37	0·38	0·39	0·40
4	0·49	0·51	0·52	0·53
5	0·62	0·63	0·65	0·67
6	0·74	0·76	0·78	0·80
7	0·86	0·88	0·91	0·93
8	0·98	1·01	1·04	1·07
9	1·11	1·14	1·07	1·20
10	1·23	1·27	1·30	1·33
11	1·35	1·39	1·43	1·46
12	1·49	1·52	1·56	1·60
13	1·59	1·64	1·68	1·74
14	1·72	1·77	1·80	1·89
15	1·85	1·90	1·94	2·00
16	1·97	2·03	2·08	2·13
17	2·10	2·15	2·21	2·26
18	2·22	2·28	2·34	2·40
19	2·34	2·40	2·47	2·53
20	2·46	2·53	2·60	2·67
21	2·59	2·65	2·73	2·79
22	2·70	2·78	2·86	2·92
23	2·82	2·91	2·99	3·06
24	2·94	3·04	3·12	3·20
25	3·07	3·16	3·25	3·33
26	3·19	3·28	3·37	3·47
27	3·22	3·40	3·50	3·60
28	3·45	3·53	3·64	3·73
29	3·37	3·66	3·77	3·86
30	3·69	3·80	3·90	4·00

For temperatures above 0° these numbers are to be subtracted from the readings.

TABLE IV.

Table of Values of log. $\frac{p}{760}$.

720	$\bar{1}$·9765189	740	$\bar{1}$·9884181	760	1·0000000
1	$\bar{1}$·9771217	1	$\bar{1}$·9890046	1	1·0005711
2	$\bar{1}$·9777236	2	$\bar{1}$·9895903	2	1·0011414
3	$\bar{1}$·9783247	3	$\bar{1}$·9901752	3	1·0017109
4	$\bar{1}$·9789250	4	$\bar{1}$·9907593	4	1·0022798
5	$\bar{1}$·9795244	5	$\bar{1}$·9913427	5	1·0028478
6	$\bar{1}$·9801230	6	$\bar{1}$·9919252	6	1·0034152
7	$\bar{1}$·9807208	7	$\bar{1}$·9925070	7	1·0039818
8	$\bar{1}$·9813178	8	$\bar{1}$·9930880	8	1·0045476
9	$\bar{1}$·9819139	9	$\bar{1}$·9936682	9	1·0051127
730	$\bar{1}$·9825093	750	$\bar{1}$·9942477	770	1·0056771
1	$\bar{1}$·9831038	1	$\bar{1}$·9948263	1	1·0062408
2	$\bar{1}$·9836975	2	$\bar{1}$·9954042	2	1·0068037
3	$\bar{1}$·9842904	3	$\bar{1}$·9959814	3	1·0073659
4	$\bar{1}$·9848825	4	$\bar{1}$·9965577	4	1·0079274
5	$\bar{1}$·9854737	5	$\bar{1}$·9971234	5	1·0084881
6	$\bar{1}$·9860642	6	$\bar{1}$·9977082	6	1·0090481
7	$\bar{1}$·9866539	7	$\bar{1}$·9982823	7	1·0096074
8	$\bar{1}$·9872428	8	$\bar{1}$·9988556	8	1·0101660
9	$\bar{1}$·9878308	9	$\bar{1}$·9994282	9	1·0107239

It may be as well to remark here that, when the bulk of the body to be weighed is small, account must be taken of the fine platinum wire to which it is hung. If the wire does not dip in the water when the body is weighed in air, we must write for W′, W′ + w'; w' being the weight of water displaced by the platinum wire. This may be drawn so fine that no correction is necessary; thus, a metre length of wire about 0·4 mm. in diameter (capable of carrying about 50 grm.), would weigh about ·06 grm.; therefore the 100 mm. forming the slip-knot and the part dipping into the water will only weigh ·006 grm., and these will lose in water about ·0003 grm., which will only affect the fourth decimal place in the result.

Suppose now the specific gravity of aluminium, silver, and platinum be taken, and for the sake of simplicity let the pieces of metal each weigh in air at 20° and 750 mm. 20 grammes. They lose in water at 10°, 8, 1·9, and ·93 grm. respectively.

According to formula A, their specific gravities would be 2·50, 10·53, and 21·50.

According to formula B, 2·499, 10·526, and 21·500.

According to formula E, respectively 2·493, 10·520, 21·496.*

A few words must now be said as to the practical part of the operation.

1. It need scarcely be mentioned, that for the determination of physical properties, pure or at least purified metals ought to be used for making the alloys; and that in stating the composition of alloys containing volatile metals, it is not sufficient to give the proportions used; in all such cases the composition must be deduced from an analysis of the alloy in question. It is scarcely possible to imagine that alloys can be made of, for instance, copper and zinc in their combining proportions; nevertheless, experimenters often give the physical properties of these alloys containing exactly the theoretical quantities of copper and zinc. The same remarks may be made concerning the alloys of copper with phosphorus and arsenic.

2. Where anything like accuracy is required, great care should be taken in making or preparing the pieces of metal or alloy of which the specific gravity is to be determined, owing to the great differences caused by a more or less vesicular structure. Take, for instance, the case of copper. Its specific gravity varies considerably, according to different experimenters; some have also found the specific gravity of this metal to be increased by pressure or hammering; but when the subject is investigated it will be found that the copper employed was more or less porous, as its specific gravity was much lower than that of a non-vesicular piece; the numbers obtained even after hammering did not come up to those given by the pure metal, showing clearly that the process of hammering had merely somewhat diminished its porosity. Again, in most of our text-books on chemistry tables of the specific gravities of copper-tin alloys are given, where the specific gravities of certain of the alloys are greater than that of copper itself, but on comparing them with the correct value for pure copper, they will be found to be much lower; in fact, it may be said that no alloy of tin and copper has a specific gravity higher than that of pure copper. These instances prove the necessity for great care in the preparation of the pieces or castings to be used in the experiment. A very good plan, where the metals or alloys are moderately fusible, is to cast them in a mould, the bottom of which is a piece of porcelain (smoked by holding it over a gas-flame), and the sides formed by cutting a hole in a piece of

* The values for μ_t used in calculating the above were, for aluminium 1·, for silver 1·00058, for platinum 1·00026.

hard wood, which is then laid on the porcelain. To prevent the formation of internal cavities, as much as possible, the casting should not be thicker than 5 mm.; and to prevent oxidation, which, of course, alters the composition, the alloy should be melted, cast, and cooled, in a current of coal-gas, or some other non-oxidising atmosphere. With regard to the more infusible metals and alloys, no general rule can be given, as so much depends on their special behaviour at such high temperatures.

Concordant results may be obtained to the second decimal place, when the casting (weighing about 20 grms.) has been prepared in the above manner, even after re-melting and re-casting, a precaution which is necessary to ensure a reliable value for the specific gravity.

3. The water used must be thoroughly boiled for some considerable time, so as to expel all the dissolved air, and cooled in a well-closed vessel. If a Florence flask be used for this purpose, it may be conveniently closed by an india-rubber tube, into the other opening of which is inserted a tightly fitting sealed tube. Care must be taken to remove any small air-bubbles adhering to the metal or alloy when immersed in the water, by means of a small camel-hair brush. It this way the results will be concordant to the second decimal place; but when absolute accuracy is required, the water must be boiled after inserting the metal, and in cases where the metal is liable to be acted on by the water it should be previously electro-gilded.

4. With a good chemical balance of the usual construction, quite sufficient accuracy is attained, as with a piece of metal of the size before mentioned, its weight in water can be determined to ·0001 grm., especially if the equilibrium be observed by reading the number of divisions marked by the index on each side of the zero point.

Should the arms of the balance be (as is not unfrequently the case) slightly different in length, recourse must be had to the method of double weighing, which, in fact, should always be adopted when absolute accuracy is desired.

From the foregoing it is scarcely necessary to remark that the formula E should always be used, as the omission of the reduction to a vacuum will cause just as great errors as those of observation.

[ERRATA.—In the former portion of this article given in our last, it will be readily perceived by our readers that a few errors escaped correction. At p. 2, col. 2, 9 lines from bottom, for the term $\sigma_t \rho_t \mu_t$, *read* $\sigma_{t\,p}\,\mu_t$; same col., 5 lines from bottom, for $\rho_{t\,p}$ and ρ, *read* $\sigma_{t\,p}$ and σ; in page 3, middle of col. 2, for Formula B and C *read* Formula C and D.]

MR. C. R. C. TICHBORNE ON PHOTOGRAPHIC CHEMISTRY.

On the Destruction of Hyposulphites in Photographic Prints. By CHARLES R. C. TICHBORNE, *F.C.S., Chemist to the Apothecaries' Hall of Ireland.*

SOME months since, there appeared in the *British Journal of Photography*, under the head of "Permanent Prints—a new Plan," a very complimentary notice of a process for eliminating hyposulphites devised by Messrs. Tichborne and Robinson. As nothing in connection with this process has been published by myself or by my friend Mr. Robinson, who has practically tested its capabilities, the following remarks may remove some erroneous impressions respecting the results obtainable with it, and afford some desired information on the chemistry of the process.*

The hyposulphites may be readily oxidised in a test tube, but when they are retained in the substance of a photographic print it is a difficult matter to effect their oxidation without impairing the image. Indeed, this practical problem has not yet been satisfactorily solved by photographers. Of the various plans that have been suggested for eliminating these salts I think I am justified in saying that the only feasible one is that devised by Mr. Robinson and myself. Permanganate of potassium, peroxide of hydrogen, the hypochlorites, and chlorine, will all act upon hyposulphite of sodium, and most of these substances have been proposed as eliminating agents. The first stains the picture, from the deposition of oxide of manganese. The second, as shown by Dr. Emerson Reynolds, is inapplicable, as sulphide of hydrogen is set free, probably according to Brodie's explanation of the reducing action of this body, viz., opposite polarity. The hypochlorites and chlorine (particularly the latter) produce fading in the prints and a yellow tone in the whites.

In a few words I may give the rationale of our anti-hyposulphite process, which consists in treating the prints with a solution of chlorate of barium, acidulated with perchloric acid. This is tantamount to using a weak solution of the latter acid. As long as there is any hyposulphite present this substance, on oxidation into sulphuric acid, sets free a fresh portion of acid from the chlorate of barium, and the reaction is thus sustained until the hyposulphite is completely oxidised. Such a procedure is found preferable to using a large

* The fact that the process was explained to our scientific friends, *viva voce*, will account for its publication in the *British Journal of Photography*.

excess of acid, which might injure the tones of the picture. The prints, *well washed*, are placed in a dish, and a considerable quantity of boiling water poured upon them. While at about this temperature (100° C.), the perchloric acid solution is added. The prints, after being allowed to soak some time, are ready to rinse and mount.

If a very weak solution of hyposulphite of sodium is treated in a flask with perchloric acid, a barium salt being present, and both solutions boiling, an instantaneous cloud of sulphate of barium is formed. If this experiment is repeated in the cold the same reaction is produced, but much more slowly, and even in the first experiment it either requires a prolonged boiling or considerable maceration before the oxidation is perfect and the last trace of hyposulphite destroyed.

But if concentrated solutions of the hyposulphite and acid are added together, as may be imagined, the first reaction of the perchloric acid is the precipitation of sulphur, which it is impossible to oxidise. There is, however, a point of attenuation of these solutions at which sulphur is never deposited. It seems as if oxidation proceeds more rapidly, even than the decomposition of the hyposulphurous acid, into sulphurous anhydride and sulphur. Thus the necessity of the prints being well washed before treating with the eliminating fluid. I believe that prints have been prepared by Mr. Robinson in this manner that were chemically free from hyposulphite of sodium, whatever other sulphur compound they might contain, and that the most fastidious could not determine, by ocular examination, which of the halves of a print had been treated with perchloric acid, and which had been washed in the ordinary manner. The process is attended with but little trouble, and will amply repay the time expended, particularly in the case of valuable photographs.

MR. BARFF ON SILICIOUS PAINTING.

On some Applications of Soluble Silicates. By F. S. Barff, *M.A. (Cantab.) F.C.S. Part I. Silicious Painting.*

Some twenty years ago Dr. Fuchs, of Munich, discovered a method of painting which he called *stereochromy*. The want of a vehicle more enduring than those formerly in use, and less liable to injure the colours employed, led to this discovery. Dr. Fuchs' method consists in the use of soluble silicates as the fixing material, and has been applied with considerable success on the continent by German artists of distinction, and in this country by Mr. Herbert in the Houses of Parliament, and by others.

The adoption of decorative and monumental painting for the embellishment of public and private buildings, has rendered necessary some changes in the older processes of painting, because the requirements are different. Wall paintings are more exposed to destructive influences than paintings on panel or canvas; the wall itself is more absorbent; the accumulation of dirt, which has from time to time to be removed, the impossibility of giving the same care to their preservation as to those of smaller size which are movable—render the employment of a different method of painting necessary, and one which will leave the picture in such a state, that it may, so to speak, take care of itself, and be independent of any further attention than that which is required to keep it clean; and for the cleaning process, its surface must be such, that it cannot be readily injured.

Oil painting is unsuited for wall pictures on account of the glossy surface which it leaves, and for other reasons, into which it is not necessary to enter here. All the expedients which have been tried to get rid of this defect have failed, because they have interfered with the permanency of the work.

Fresco painting is open to many objections. In a damp climate it is not enduring. It is well known that the face of a plaster wall is destroyed by damp; and a fresco painting is nothing more than a plastered wall with a coloured surface, rendered more perishable by the colours, which, to some extent, interfere with the coherence of the particles of lime and sand forming that surface. The painting is executed while the wall is wet; water and lime only are used with the colours; their adhesion, therefore, is effected by the same power which binds together the other constituents of the wall, viz., the union between the lime and sand; and inasmuch as most of the colours form no compound with lime or sand, they must tend to weaken by their presence the cohesion between these substances by interfering with their perfect contact. The manipulation in fresco painting is difficult, requiring great care and skilled labour of a particular kind, only to be acquired by long practice and considerable observation, and is, therefore, unfit to be entrusted to workmen of the kind usually employed in decorative work. From the slowness of the process, it becomes very expensive, and this alone would prevent its general use, even if it were in other respects satisfactory.

Silicious painting seems to supply all that is wanted for beauty and stability. It makes the surface of the wall almost impervious to moisture, it fixes the colours firmly to the ground, it leaves no gloss, and, as will be seen, is easy of application. But the process discovered by Dr.

Fuchs seems incomplete and open to some grave objections, although the principle on which it rests is sound.

Silica is soluble when fused or boiled under pressure with excess of caustic alkali. The compound thus obtained is a viscid, sticky, liquid, of syrupy consistency; for many purposes it is a better adhesive material than gum, and its effect as a fixing medium is to bind colours very firmly to certain surfaces; it binds them, however, as a gum, though in some instances it fixes them by a chemical action; but this cannot be depended upon as securing the stability of a painting, as it only happens where the colours used form chemical compounds with the silicate, and this is the exception. When a soluble silicate is applied to a surface containing a substance with which it readily unites, a portion of the silica in solution will combine with it; and in proportion as the silica is precipitated the alkali which held it in solution will be set free, and therefore the remaining silicate will become more alkaline and more soluble. This is proved by exposing a piece of stone, such as Caen stone, coated with silica, to the action of the atmosphere; the silicate, which at first dried with a glossy surface, gradually dissolves, being acted upon by the moisture of the air, and that which had penetrated to a slight depth into the stone behaves in the same manner, and loosens the particles on its surface.

This seems to form a serious objection to the use of soluble silicates, either for stone preservation or stereochromic painting; and it is a difficulty which those who have worked upon soluble silicates have found very troublesome to remedy. The fact that silica combines with lime, sand, and other substances used in the painting ground, is indisputable; but this very combination leaves behind that which in the presence of moisture has a destructive action on the ground which it is intended to preserve, and on the colours applied to it. In painting a picture, especially one of large dimensions and in ornamental painting, the colours are often laid on in thick masses; but if these colours do not combine chemically with silica they will be only mechanically fixed to the wall by the silicate; and as this silicate, which was soluble before application, remains so afterwards, unless it form an insoluble compound with some other substance, the simple action of damp continued for some time will loosen and eventually remove the colours. Now, many of the pigments used in painting, such as ochres, umbers, certain reds and blacks, do not combine with silica; and as they are frequently used pure or nearly so in the glazing and finishing touches, on which the effect of a picture mainly depends, they cannot be permanently fixed, and such is proved to be the case by the experience of those who have given the subject patient and careful investigation. There are, doubtless, many silicious paintings which have stood for several years; there are also distemper paintings which have lasted for many more. In sheltered situations and in interiors it is quite possible that this may be the case; but even here repeated applications of silicious washes have been made at intervals, after the completion of the work, and such a practice is recommended for refixing particles of colour which may, after a time, have become loosened.

The above remarks are not intended to disparage Dr. Fuchs' discovery, which is, in truth, one of the most important to art ever made. To this modest and great man all who are interested in the advancement of art owe a deep debt of gratitude for his persevering labours, pursued for many years amidst much discouragement and many difficulties. Those who read his treatise on stereochromy cannot but feel delighted with the earnestness and singleness of purpose with which he laboured to attain the high end which he set before him. He thus concludes the account of his investigations:—"But, before all, I thank God, who graciously allowed his weak and aged servant to finish the preceding investigations so far, that others may build upon the foundation that I have laid." He evidently saw that much remained to be done to perfect the process which he had originated.

This paper has been written to lay before those who feel interested in the matter certain facts which are the result of some years' experience, and also to induce those who are engaged in art pursuits to turn their attention seriously to a process which, by rendering their works lasting and in all respects better suited to supply an increasing want, will make their profession more remunerative and their exertions more conducive to the happiness and improvement of their fellow-men.

If artificial ultramarine be mixed with a soluble silicate, for example silicate of potash, and be laid on a properly prepared ground, it will become so firmly fixed that no amount of washing nor the slow action of moisture will remove it or affect its brilliancy. If, however, reds, such as vermilion, red ochre, some of the oxides of iron; or browns, such as umber or sienna be similarly treated, they will not endure the same test. Why is this? Ultramarine contains 37 per cent. of silica and 27 per cent. of alumina, two substances with which a soluble silicate readily unites. It is well known in laboratories that test tubes and other glass vessels, which have contained soluble silicates,

become corroded, and that it is impossible to separate the silicious crust from the glass. There is in all soluble silicates, unless specially prepared, an excess of alkali; this, no doubt, acts on the glass vessel, and, by partly dissolving it, facilitates the union of the silica deposited from the solution, with the softened particles of its surface. In time the alkali becomes saturated with the silica of the glass vessel, and when this saturated silicate is dry it is much less soluble than when excess of alkali was present. Alumina readily unites with silica in the soluble form, whether the alumina be in solution or not, though in the latter case the action is much slower. It also takes into combination with it a certain quantity of the alkali, forming a compound analogous to felspar. It is not, therefore, difficult to account for the stability of the product resulting from the mixture of ultramarine with a soluble silicate. This fact points out the direction in which investigations should be made for the improvement of silicious painting. It will be well to consider briefly, first, the method of preparing colours; then the preparation of the painting ground; afterwards the solution to be used as the painting vehicle; and, finally, the method of manipulation and the permanent fixing of the picture. Alumina forms very stable natural compounds with silica, potash, soda, and lime. Felspar, which enters largely into the composition of granite, consists mainly of silica, alumina, and potash. Porphyry, red and green, is a very enduring substance, and is also a species of felspar. Basalt, labradorite, and albite, are formed of silica, lime, potash, and alumina, variously combined. Labradorite contains lime and albite soda, in union with silica and alumina. All these minerals are hard and enduring. It is quite possible to produce, artificially, substances approaching their composition which will resist the action of damp and other destructive agents to which paintings are always exposed. Judging from the behaviour of ultramarine, if the colours employed contain silica and alumina, they should adhere as firmly to the surface on which they are placed, and such really is the case. If alumina be fused with potash, aluminate of potash is formed, containing a large quantity of alumina. If this be dissolved, so as to form a solution of sp. gr. 1·12, it may be kept for several days; if a stronger solution be made, it begins very soon to deposit alumina. The solution sp. gr. 1·12 mixed with silicate of potash sp. gr. 1·2 will remain liquid for twenty-four hours, or perhaps a little longer; after that it will gelatinise slowly. If, while in the liquid state, colours are saturated with this solution, and are allowed to dry, their particles will be very intimately mixed with silica and alumina chemically combined with potash; after drying for some time at a gentle heat, the operation may be repeated, and any quantity of the silicate of alumina and potash may be thus mixed with the colours. Care should be taken that they be finely powdered between each application, and they should be stirred up so as to keep them from caking at the bottom of the vessel, which hinders the perfect contact of the particles with the liquid. After careful drying for some days they may be well washed for the removal of any uncombined potash. The admixture of silica and alumina does not interfere with the brilliancy or depth of the colours. This method may be used for all colours, but it is better suited for such as ochres, umbers, siennas, etc., which are changed in tint by exposure to a high temperature. The different pigments made from metallic oxides, such as iron reds, cobalt blue, chromic green, etc., are better prepared by precipitation, as silicates and aluminates, by the addition of the mixed silicate and aluminate of potash to any of the solutions of their oxides in mineral acids. The precipitate should be well washed, dried, ignited, and ground. Colours made by the same method as those used in painting on porcelain (*i. e.* by fusion), where the colour is not affected by intense heat, answer perfectly well, as they contain silica to which alumina can be added in the process of manufacture. Excellent reds, greens, browns, and some yellows, can be procured in this way. The object of using colours which contain silica and alumina has already been stated to be the formation of coherent insoluble compounds with the vehicle used in painting, which will be subsequently described.

LABORATORY NOTES.

On the Action of Zinc on Trichloride of Phosphorus and Iodide of Ethyl. By Ernest Theophron Chapman *and* Miles H. Smith.

We have recently had occasion to prepare some of the acids of the lactic series by heating zinc, iodide of an alcohol radicle, and oxalic ether together. It occurred to us that we might perhaps extend the process to the preparation of the triphosphamines. We, therefore, digested zinc, iodide of ethyl, and trichloride of phosphorus together in a sealed tube in the water-bath. It was 8 or 9 hours before any action occurred; then the contents of the tube became orange, and the zinc was covered with a brownish orange coating which held it together, so that on reversing the tube it did not move. At this stage of the process the tube was allowed to cool. It was then seen that in the spaces between the pieces of zinc,

orange or rather almost scarlet crystals had formed in abundance. The tube was then re-heated. The crystals dissolved again at once, and on reversing the tube and allowing it to cool in this position they were again deposited, but this time they were clear of the zinc. The mother liquor was removed from them by turning the tube in such a manner that it ran back upon the zinc. The top of the tube was then cut off, and the crystals removed and dried in a stream of dry carbonic acid.

A combustion was made of them with chromate of lead, but they gave off neither carbonic acid nor water. They were then carefully analysed and proved to be pure *biniodide of phosphorus.*

The contents of the tube after the crystals and mother liquor had been removed, when treated with water, gave off a gas free from phosphorus, and possessing the properties of hydride of ethyl. At the same time a brown substance was formed, which, when filtered off, was found to contain zinc, and to yield phosphuretted hydrogen on boiling with potash. Long boiling with water had the same effect.

The filtrate was found to consist of a solution of chloride and iodide of zinc, though but little of the latter in proportion to the former, in fact not more than a trace. Not a trace of tri-ethyl phosphamine was produced in this experiment.

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EDITORIAL NOTES.

CHEMISTRY FOR MEDICAL STUDENTS.

THE importance of Chemistry as a part of medical education is every day becoming more and more admitted by the profession at large; and has been more than once insisted on by men who have attained eminence by their own labours in the application of the science to physiological questions. It would be superfluous to recall to our readers the many useful results which have been obtained in this way, or to do more than hint at what may be expected from a continuance of such inquiries. At the Nottingham meeting of the British Association Dr. Bence Jones expressed his "conviction that whenever the most perfect knowledge of Chemistry and Physics becomes the basis of rational medicine, then, and not till then, medicine will obtain the highest place among all the arts that minister to the welfare and happiness of man."

Starting with this admission, a question directly arises whether, in the present state of medical education, we employ the best means of imparting to students a knowledge of Chemistry calculated to be of use to them in their future career. For some time past the science in question has been making enormous advances in all its branches, and these advances have occasioned what may fairly be called a revolution. In fact, at the present time Chemistry is in a transition state, which is quite sufficient to account for the difficult position in which teachers are placed. The difficulty is double. In the first place, how much is to be taught? In the second place, what system is to be followed?

The time allowed in the usual course for Chemistry is absolutely insufficient for the acquisition of more than a smattering of the subject, because the lecturer is bound to notice all such points as go to make up the knowledge required by several different examining boards; and until the study of Chemistry becomes a preliminary part of medical education, this difficulty must in great measure remain. In fact, the aim of the teacher is necessarily to enable his pupils to pass all these examinations; and this is, we venture to say, not the same thing as giving the student a practical knowledge of such branches of the subject as he would subsequently find really advantageous.

From the various systems in use we may take one or two examples to show the confusion likely to be produced in the ideas of a student on commencing the subject. In one book he will find a substance called carbonic acid; the same body is called by another authority carbonic anhydride, and by a third carbonic dioxide. Again, we may take the two sulphates of potash; these are called—

1. Dipotassic sulphate and hydro-potassic sulphate.
2. Sulphate of potash and bisulphate of potash.
3. Neutral sulphate of potash and acid sulphate of potash.
4. Potassium sulphate and potassium-hydrogen sulphate.
5. Dipotassium sulphate and hydric-potassium sulphate. Etc. etc.

Represented in symbols they will be found as:

$$1.\ KO, SO_3 \text{ and } KO, SO_3 + HO, SO_3$$
$$2.\ K_2SO_4 \text{ and } KHSO_4;$$

the first formula giving no indication of what is clearly shown by the second, namely, that sulphuric acid is bibasic. Again, in many books a molecule is defined as the smallest proportion of an element capable of existing in the free state; nevertheless, such reactions will be found in them as

$$HgO = Hg + O,$$

where the mercury and oxygen are liberated as half molecules, or atoms, in direct contradiction

to the definition. This is said to be done for the sake of simplicity in the formula; but it appears to us that such simplicity is dearly purchased at the expense of truth and logic: indeed, on the same grounds we might expect to find the old atomic weight of oxygen substituted for the new, according to convenience. Lastly, in some recent works, graphical representations are given of chemical compounds, which we cannot but consider as quite inappropriate to a text-book, however suggestive they may be to those who are engaged in the abstract study of the science.

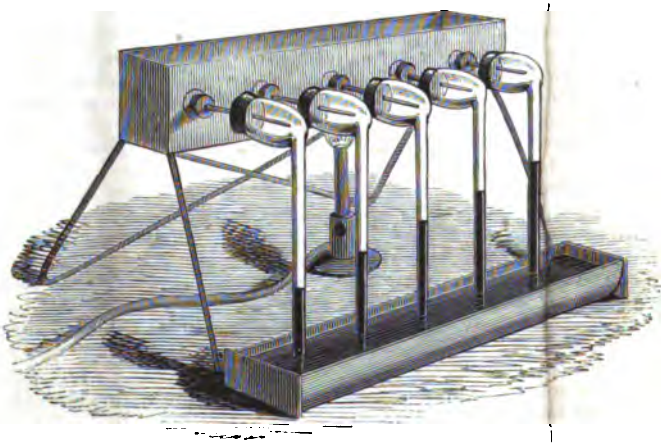
When we consider, also, that the Examiners only hold office for certain periods, and that the question put by one in the one system may be put in the next year by another in a different system, it will be obvious that the positions of both teacher and learner are sufficiently trying, and that the introduction of some mutual understanding among chemists generally would be a very great advantage.

C. H. BENNETT.

Death has just snatched from us a clever artist and true humourist, whose pencil enriched the pages of 'Punch' with some of its best pictorial bits. Perhaps this passing tribute to the genius of Mr. Charles H. Bennett would be out of place in these columns were it the case with him, as with most of his fellow-workers of the crayon, that he lacked sympathy with men of science. Many of our readers must have smiled at his portraits of 'The Philosophers of Nottingham.'

APPARATUS FOR SHOWING THE HEAT-CONDUCTING POWERS OF METALS.

In last week's number we gave an account of a differential thermometer used by Dr. Matthiessen for some experiments with alloys in his recent lecture before the Chemical Society. On the same occasion the heat-conducting powers of different metals and alloys were shown by means of a series of small air-thermometers into the bulbs of which the ends of the metal rods were passed. The construction of the apparatus will be immediately understood from the subjoined engraving. The bars of metal are fitted into the wide bulbs of the tubes by tightly-fitting corks. The ends of the bars inside the bulbs are blackened; the other ends are immersed in hot water contained in a trough. Screens which could not be shown in the drawing are used to prevent any radiation from the source of heat or the trough itself. The small ends of the tubes dip into a vessel of coloured water, which is made



to rise to the same level in all by carefully warming the bulbs and then allowing them to cool.

If we now suppose the series of bars to be copper, aluminium, zinc, tin and bismuth; on pouring boiling water into the trough, a depression will be caused in the level of the liquid in the tubes, being the greatest in the case of the copper, and gradually decreasing to the bismuth, and the depressions in the columns will approximately represent the ratio between the conducting powers of the metals, which ratio will remain constant for a considerable length of time. The advantages of the new over the old form of apparatus will doubtless lead to its adoption for class demonstration.

LITERATURE.

The Student's Text-book of Electricity. By Henry M. Noad, Ph.D., F.R.S., F.C.S.—London: Lockwood. 1867. (8vo, pp. viii and 519.)

There is, perhaps, no department of physical science in which the discoveries of the last fifty years have been more numerous or of greater importance than those with which our knowledge of electricity has been enriched during this period. The most important and fundamental of these discoveries, however, receive very little prominence in most of the elementary works on this branch of science, compared with that given to practical inventions, such as the electric telegraph and the processes of electro-plating, or to apparatus like the hydro-electric machine or the electric lamp whereby brilliant displays can be made in the lecture-room. The abundant space and profusion of woodcuts which are almost always bestowed upon such subjects as these, compared with the complete exclusion, or, at best, the curt treatment which has been the too frequent lot of such fundamental laws of the science as those of Ohm and Joule, and of the principles and application of such apparatus as the tangent-galvanometer, or Weber's electro-dynamometer, remind us strongly of the different kind of reception which a successful man who has made his fortune or a man of brilliant social qualities, meets with in society, from that which is often accorded to one whose eminence is merely intellectual, or who is content to be doing the really useful work of the world without seeking notoriety. We do not, of course, wish to see the former class of subjects omitted: all we complain of is, that what are, after all, frequently mere details of mechanical contrivance, should receive a degree of prominence which is denied to matters of indefinitely greater scientific importance

But, having thus indicated what appears to us to be a general defect in elementary works on electricity, it would be unjust if we did not acknowledge that some of the most recent of them afford evidence that their compilers are at least beginning to feel that the contents of a book on science should be scientific, and should comprise something more than explanations of practical inventions or descriptions of showy experiments. So much, at any rate, may be said at the outset in praise of the book before us. It contains a considerable quantity of matter which we do not remember to have met with in any other similar work, and which shows that Dr. Noad fully appreciates the importance of the progess that has been made of late years in giving to the laws of electrical science greater coherence and comprehensiveness. The extracts he has given from the Reports of the Electrical Standard Committee of the British Association, Mr. Latimer Clark's instructive report appended to the Report of the Submarine Telegraph Committee, Mr. Fleeming Jenkin's Cantor Lectures, and other modern publications of a like nature, are of the greatest value, and go far towards putting within reach of the student a great deal of most important information which otherwise would not be easily accessible to him. Unfortunately, however, although Dr. Noad has put all this valuable matter before the student, he has not presented it to him in a form well fitted for a student's use. Instead of working it up into a connected form, and giving an independent exposition of the subject from his own point of view, he has generally retained, with little or no alteration, the words of the various authors he has quoted. Where the object is to trace the development of a discovery or the growth of an idea, such a mode of proceeding is often extremely advisable; but it is seldom beneficial when what we have to do is to expound as fully as possible the import of a highly elaborated system of truths—not to relate the history of their discovery. It is seldom that a scientic man, writing a paper addressed to scientific men, whom he frequently knows to be as well acquainted with many parts of his subject as he is himself, adopts the style best fitted to render his meaning clear to beginners. In the present case, the result of retaining so nearly the original expressions of the writers quoted, and sometimes joining together, as though they were parts of one continuous exposition, extracts from different authors addressing different audiences from different points of view, is to produce a disconnected, patchworky sort of effect which tends to anything rather than clearness and comprehensiveness of ideas on the part of the reader.

A further necessary result of Dr. Noad's persistent shrinking from saying anything that can be avoided in his own words, is that several important subjects which apparently he did not find already treated in a form well adapted for quotation are either passed over altogether or are very inadequately discussed. Thus, at pp. 200, 201, a unit magnetic pole is mentioned more than once (in passages quoted from Mr. Jenkin), and at p. 136 the intensity of terrestrial magnetism at several stations is stated in absolute measure; yet we nowhere find any explanation of the method by which magnetic force can be reduced to absolute mechanical measure, nor even any exact definition of what is meant by a unit magnetic pole. Again, the law established by Joule with regard to the heating effects of the current—namely, that the quan-

tity of heat evolved in a given time in a given portion of the circuit is proportional to the resistance of this portion and to the square of the quantity of electricity passing—is very shortly stated, in what seems an almost incidental manner, at p. 189, and is perhaps implied in a not very clearly worded paragraph near the bottom of p. 190; while at the top of p. 191 is a statement which, as it stands, implies that the heating power of the current is simply proportional to its intensity (in the sense of quantity of electricity per unit of time). Assuredly, the learner would find it difficult to form a satisfactory notion of this law from a combination of the various passages bearing upon the subject. Of Favre's beautiful experiments upon the quantity of heat developed when the current is made to do chemical or mechanical work, we find no mention at all. Another important point of which we find no sufficient statement, is the production of induced currents in a conductor moved in proximity to a conductor carrying a current, and the law by which Lenz showed that the direction of such currents, as well as of those caused by the mutual motion of magnets and conductors, is determined.

The selection of the matter which the book contains appears to us on the whole to have been made with great judgment, though we might refer to certain conclusions of Sir W. S. Harris and of Mr. Whitehouse as being invested with rather more authority than belongs to them. Although many passages appear to us somewhat wanting in clearness and precision, we have detected very few decided errors—a rather serious one, however, occurs on page 200. To indicate it, we must quote the passage:

"In the absolute electro-magnetic system of Weber and Thomson the following equations exist between the mechanical and electrical units (*Jenkin, Proc. Royal Soc.*, vol. xiv, p. 158):

$$W = C^2Rt \;\ldots\ldots\ldots\ldots\; (1)$$

where W is the work done in the time t by the current C conveyed through a conductor of the resistance R. This equation expresses Joule and Thomson's law,

$$C = \frac{E}{R} \;\ldots\ldots\ldots\ldots\; (2)$$

where E is the electromotive force. This equation expresses Ohm's law,

$$Q = Ct \;\ldots\ldots\ldots\ldots\; (3)$$

which again expresses a relation first proved by Faraday, where Q is the quantity of electricity conveyed or neutralised in the time t."

The simple substitution of commas for full stops after "This equation expresses Joule and Thomson's law" and "This equation expresses Ohm's law," whereby these two sentences are made to refer respectively to equations 2 and 3, instead of to equations 1 and 2, as they do in the original from which Dr. Noad has quoted, turns both of them into nonsense. We felt no doubt that this substitution was a mere typographical error, until we observed that the words immediately following equation 3 in the original are "expressing a relation first proved by Faraday," etc., instead of "which again expresses," etc.

In conclusion, we cannot help expressing our regret that, with the great industry and judgment he has shown in the collection of his materials, Dr. Noad should not have produced a much better book. The general impression it leaves upon us is that of a good dinner put upon the table uncooked.

CHEMICAL SOCIETY.

THURSDAY, APRIL 4.

Warren De la Rue, Esq., Ph.D., F.R.S., President, in the Chair.

The minutes of the last ordinary meeting, and also of the anniversary meeting, were read and confirmed.

Donations to the library were announced and accepted with thanks.

Mr. Frederick S. Barff, M.A. (Cantab.), and Mr. Alfred Tribe, were formally admitted Fellows of the Society.

The names of candidates for election read for the first time were—William Gowland, Sheffield; George Robert Gowland, Sheffield; John Cargill Brough, Stockwell; Edward Packard, Ipswich; F. W. Petterson (of Her Majesty's Mint, Calcutta), Myddleton Square.

For the second time were read the names of,—William Phipson Beale, Lincoln's Inn, and Alfred Coleman, Plough Court.

The following gentlemen were balloted for and duly elected Fellows of the Society:—David Skinner Kemp, Bombay, and John Mackay, Edinburgh.

Dr. Gladstone made some remarks on the supposed impossibility of recrystallising glycerin. He said that those of the members who had been present at the last meeting would recollect the specimen of frozen glycerin exhibited by Dr. Squire, and his statement that when once melted he had been unable to procure it again in a solid state, either by intense cold, accompanied by shaking, or even by introducing some of the crystals into the cooled substance. Dr. Squire had kindly given him a portion of the specimen, which he had placed in a bottle, and taken home in his pocket. It had then partially melted. He placed it outside the window for the night, and in the morning (a fall of snow having taken place) he thought the proportion of crystals had increased. After remaining some time in a cold part of his laboratory, they had decidedly increased in quantity. The bottle was then placed on the mantelpiece, where the crystals, becoming warm, soon began to decrease; on removing them to a colder room they again grew.

Dr. Gladstone exhibited the specimen of glycerin, of which about one third was in the solid state, having much the appearance of lump sugar.

The President thanked Dr. Gladstone for his interesting remarks, and said that it was very desirable to know the conditions under which glycerin crystallised, for that it had seemed to him improbable that the fused glycerin should not be again obtained in the solid state.

A paper was then read by the Secretary, Mr. Vernon Harcourt, "*On the Oxidising Power of Charcoal.*" This paper had no signature, but was believed to be by Mr. J. Hunter.

The author first referred to the well-known power which charcoal had of condensing gases within its pores, and to the experiments of Dr. Stenhouse, made many years ago, illustrating the capability of charcoal for rapidly oxidising the gases given off from putrescent animal matter, so that when covered with a thin layer of powdered charcoal, no odour could be observed. The author was induced, by the consideration of this property of charcoal, to endeavour to determine its maximum oxidising power, and its applicability to the oxidation of organic products. For this purpose cubes of boxwood charcoal were prepared and purified by boiling with dilute hydrochloric acid, and afterwards washing carefully with distilled water and drying. These cubes were heated to redness, and then introduced into a graduated tube filled with oxygen standing over mercury, and left until there was no further absorption of the gas, which took about twenty-four hours. Before experimenting, it was necessary to ascertain that oxygen itself had no action on the charcoal employed. It was found, on trial, that no sensible quantity of carbonic acid was produced, even after a protracted contact of the two substances. When moist sulphurous acid gas was brought in contact with the charcoal previously saturated with oxygen, sulphuric acid was produced. A cube of the charcoal introduced into 100 measures of oxygen standing over mercury, after twenty-four hours, had absorbed 44 measures. 44 measures of hydrosulphuric acid were then introduced, again making up the 100 measures. When absorption had again ceased, it was found that 72 measures had disappeared, therefore 28 measures of oxygen had been used. Sulphuric acid was produced. On repeating the experiment, substituting ammonia for sulphuretted hydrogen, there was an absorption, but no nitric acid was formed. From this experiment the author concluded that T. De Saussure's opinion that one gas displaces another from charcoal was incorrect. Phosphuretted hydrogen, obtained by heating alcoholic potash and phosphorus, was absorbed and phosphoric acid produced. The second series of experiments were made to determine the products obtained by oxidising organic substances by means of charcoal. On introducing a little methylic alcohol into the tube of oxygen containing the charcoal cube, the oxygen was gradually absorbed, and after seventy-two hours the charcoal was removed and extracted with water. Silver salts were reduced by this solution, but the author was doubtful as to its being formic acid, as it did not appear to reduce the salts of mercury. With ethylic alcohol much more positive results were obtained. Acetic acid was produced, which was recognised by its conversion into cacodyl and acetic ether. Amylic alcohol, when similarly treated, gave valerianic acid. Ethylene, C_2H_4 gave no liquid or solid products, but on boiling the charcoal with water, and passing the evolved gases through lime water, a precipitate of carbonate of calcium was formed. Propylene C_3H_6, obtained from iodide of allyl by heating it with mercury, and hydrochloric acid, gave similar results. Amylene also gave carbonic acid, and some other product, as there was an odour of one of the amylic ethers; but the author was unable to determine which. There were two theories of the action of charcoal, one was that the oxygen condensed on the surface of the pores of the charcoal dissolved the other gas. The second, which the author thought most probable, was that both gases were condensed by the charcoal.

The President said that the condensation of gases by charcoal was a curious problem, as a great force was brought into action, being equal, in some instances, to a mechanical pressure of several tons on the square inch. In the case of oxygen it was, however, comparatively small, probably not more than half a ton to the square inch. He would not like to say that the oxygen was in the liquid state; our ideas of what was a liquid and what was a solid must be considerably modified. We usually regarded tin and copper as solids, but in some cases they behaved like a viscid liquid. For instance, in the manufacture of tin tubes for artists' colours, the tin, under great pressure, squeezed out round the core; and in striking medals, when the die came upon the copper, the metal was squeezed out and it filled up every minute space.

Mr. J. Spiller said that at the meeting of the Society on 7th March, Dr. Calvert had described some interesting results which he had obtained by the action of charcoal impregnated with oxygen on different substances, which were identical with those in this paper, and also stated his intention of communicating a paper to the Society on the subject. As the paper just read had no signature, he considered it likely that the author was Dr. Crace Calvert.

The President, after mentioning that they had been disappointed in not having the paper which Dr. Russell had promised them on Gas Analysis, proposed that the Fellows should adjourn to the Royal Society, where Professor Abel was to read a paper on Gun-cotton.

The meeting was adjourned until April 18th.

[The names of the Fellows elected as *Members of the Council* at the Anniversary Meeting were not included in our Report. We now supply them: F. Crace Calvert, F.R.S.; J. Lothian Bell; Dugald Campbell; W. Crookes, F.R.S.; F. Field, F.R.S.; David Forbes; G. C. Foster; A. Matthiessen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; J. A. Wanklyn.]

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY

C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS, *April* 8th.

THROUGH the culpable shortcomings of M. Mazaroz, the English chemical department is still in a very unfinished condition. The exhibitors are justly loud in their complaints of the manner in which they have been treated by this gentleman. M. Mazaroz has failed in every instance to keep his word with those exhibitors who have been unfortunate enough to employ him. It seems that the cases in which the products of Class 44 are displayed, are only lent by M. Mazaroz at an absurdly exorbitant rent, and now, if an exhibitor dares to employ a workman to paint up a name or put in a square of glass so as to complete the work left unfinished by this pearl of contractors, he threatens them with the terrors of the Code Napoleon for interfering with his property. If he sends his men to finish the work, they coolly demand payment of the exhibitor for what they have done; indeed, in one instance a painter was sent by M. Mazaroz to write a name and address upon the frame of a showcase; when he had finished his work, he made out an outrageously exorbitant bill, and asked for a settlement. The exhibitor naturally refused to pay him, M. Mazaroz having included all such work in his contract; whereupon the workman took up a brush full of black paint, and effaced what he had written with all the *nonchalance* possible. It seems almost out of place in a scientific journal to notice quarrels between contractors and exhibitors, but the present circumstances are so exceptional, and have so retarded the arrangement of the products, that it is simply necessary to notice them in order to account for once more delaying the commencement of a systematic description of the chemicals displayed. It is bad enough when exhibitors themselves find it impossible to finish their work in two or three days, as they fondly supposed they would be able to do; but the matter becomes very serious when a foreman or manager is sent over by a firm, and is obliged to treble and quadruple the time of his stay in Paris; his principals naturally thinking that his prolonged absence is due to the fascinations of the gayest of European cities, and not to the neglect of M. Mazaroz. This is a somewhat delicate point to touch upon, but to leave it unnoticed would be an act of injustice to the hard-working representatives of British exhibitors.

As for the general distribution and arrangement of the small modicum of space devoted to chemical products, very little that is eulogistic can be said. The officials who have had charge of this particular department have evidently thought that the most important products to be exhibited were starch, aërated waters, plate powder, furniture polish, and baking powder, these products having a perfectly preposterous amount of room given to them. A few examples taken at random will be sufficient to prove the truth of this assertion. The amount of frontage given to Messrs. Condy, who exhibit a large number of most interesting manganic compounds, is about 3 feet. Messrs. Hopkin and Williams are obliged to cram sixty or seventy specimens of thallic salts into 4 feet. Messrs. Muspratts are condemned to even less, while Messrs. Huskissons have been allowed only 3 feet for a most extensive series of iodine and bromine compounds; and Messrs. Foot and Co. are compelled to exhibit their specimens of acetic acid and its salts within a space of 18 inches. As a contrast to this Procrustean treatment, Mr. Borwick, of baking powder celebrity, is the happy possessor of nearly 6 feet of frontage. Mr. Adams, who exhibits plate powder and furniture polish, has nearly the same amount of space. Messrs. Ash & Co. exhibit some thirty samples of manures in a case 9 feet long, while Messrs. J. J. Colman, for a single article, viz. starch, have been given 6 feet. The aërated water makers have been treated with similar liberality, Schweppe, Twinberrow, and Fleet dividing between them no less than 20 feet of frontage. With the exception of Mr. Borwick's baking powder and Mr. Adams's furniture polish, the above-mentioned articles are legitimate chemical manufactures, and are deserving of a certain amount of attention; but when it is found that they are considered as of more importance than many of the products which have made England the first chemical manufacturing nation in the world, we can only ascribe the committal of such an absurd blunder to either gross ignorance or gross carelessness. The worst of the whole affair is, that the respected name of Dr. Frankland is given in the Directory attached to the British Catalogue as Secretary for organising this portion of the Exhibition; but we are very certain that this gentleman had nothing whatever to do with the distribution of space or the selection of exhibitors.

There are also products exhibited which ought never to have been allowed inside the building. Mr. Borwick, who wrongfully describes himself in the Catalogue as exhibiting chemicals, fills up that portion of his case that is not occupied by packets of baking powder and flaring show-cards, with sundry bottles of a substance which he terms "ozonised cod-liver oil." This singular compound of ozone and organic matter ought surely to be brought under the notice of Professor Schönbein and Sir Benjamin Brodie, more especially as it is stated to be "the nearest approach to a specific for consumption yet discovered," in a full-page advertisement to be found in the so-called Appendix to the British Catalogue.

But worse remains behind; for on examining the cases of certain firms, whose names we withhold for fear of incurring the penalty of several actions for libel, we find exhibited such compounds as the artificial essences of sherry, port, gin, rum, cognac, arrack, madeira, moselle, etc. Now, these essences can only be used for the purpose of swindling the public, by enabling fraudulent publicans and grocers to manufacture those pernicious compounds with which the poorer classes of Her Majesty's subjects are slowly

poisoned. In the Exhibition of 1862, a sensation collection of substances used for adulteration was displayed in the Food department, terrible examples of what manufacturers were capable of; but in 1867 we improve on it by allowing the manufacturers themselves to exhibit the adulterants most in vogue. No doubt, on examination we shall find Mr. Casely, the burglar, exhibiting his safe-breaking tools, and humbly endeavouring to earn a medal. A few forged bank-notes or cheques might possibly merit the commendation of the jury for the liberal arts, and some electro-plated shillings and sovereigns might divide the palm of excellence with the noble productions of Messrs. Elkington and Co.

The juries have already begun their labours. Up to April 2nd it was generally understood that the work of examining the products exhibited would not commence until the 15th, owing to the confusion reigning in the building; but on the former day, the Imperial Commission, with that suddenness of decision which has characterised so many of their movements, issued an edict to the various foreign commissions to telegraph immediately to their jurors. The English and French exhibitors are pretty well advanced, and the jurors will be able to pick out many cases for examination; but in the other departments they will only be able to carry on their work at the risk of breaking their limbs and tearing their clothes.

After having said so much that is severe, it is quite a relief to discover a little oasis where the highest praise may be indulged in. About four weeks ago, when the officials found that it was impossible to work twenty-four hours per day, they wisely telegraphed for Mr. S. L. Howard, the Associate Commissioner of Class 44. This gentleman arrived by the next mail, and immediately doffed his coat, both morally and physically, and went to work. He seems to have forgotten all through that he was a competitor of many of the exhibitors, and has laboured unremittingly for everybody's advantage. Mr. Howard has earned the goodwill of all his fellow-workers for the decision, energy, and good temper he has shown throughout. Nothing appears to have come amiss to him, from scolding French workmen to calming furious exhibitors, between whom and M. Mazaroz he has acted as moderator.

The exhibitors are also loud in their praise of the British executive, who, in spite of having been overworked, have all through shown the greatest courtesy and willingness to help them in every way. Mr. Cole has nearly lived in the building; and his able coadjutors, Messrs. Owen, Thompson, and Wright, who have already passed unscathed through the fiery furnace of many exhibitions, have worked hard and successfully in enabling British manufacturers to prove that we hold our own against all comers.

We are compelled to omit the Report of Dr. Frankland's second Lecture on Coal Gas in consequence of its great length. It will certainly appear in our next.

CORRESPONDENCE.

SAFE PETROLEUM.

Some few months ago a number of merchants, brokers, dealers, and other gentlemen interested in the sale of petroleum, assembled in the Baltic saleroom in the city, and after some discussion, relating chiefly to the inconveniences caused by the great variation in results on testing petroleum, according to the demands of the Petroleum Act of 1862, passed the following resolution:—"That in the opinion of this meeting the present unsatisfactory state of the petroleum trade, with reference to the quality and decisions by arbitration, renders the formation of an association to regulate the trade highly desirable." Several gentlemen were then requested to form a committee for the purpose of drawing up, and submitting for approval of another general meeting, such rules and regulations as might be considered necessary. Now, the wording of the Act, concerning the inflammable quality of petroleum, is remarkably clear:—"Petroleum shall include any product thereof that gives off an inflammable vapour at a temperature of less than one hundred degrees of Fahrenheit's thermometer"—but the method by which that quality shall be experimentally ascertained is not described in the Act, hence the difficulties alluded to, different operators giving different degrees as the inflaming-point of a sample, and an operator not unfrequently giving different degrees at different times as the inflaming-point of the same specimen. The causes of this variation and a trustworthy method of ascertaining the point at which petroleum gives off inflammable vapour sufficiently fast to form an explosive mixture with the air in the reservoir of a lamp or other closed or partially closed vessel, have already been described by the writer; the application of the method being followed by the startling fact, that probably there is not a single cargo of refined petroleum imported into this country, and distributed to the public, but what "gives off an inflammable vapour at" less, generally considerably less, "than one hundred degrees of Fahrenheit's thermometer." The explanation of this dangerous state of things is said to be this—that not only the members of the petroleum trade, but the framers of the Petroleum Act, considered the inflammable quality of petroleum to be correctly indicated by the temperature at which it permanently ignited when heated in a small dish or cup, a lighted match or taper being passed over or dipped into it every few seconds. Every operator noticed that before this temperature was reached a flash, due to the ignition of petroleum vapour, often occurred; but as the liquid itself did not catch fire the flash was by common consent disregarded, no one, apparently, reflecting that it was this flash that caused explosions in lamps. Well, these matters having been considered by the committee of the Petroleum Association, that body has recommended that the inflammable quality of petroleum shall be considered to be correctly indicated by the mean of the temperatures at which the petroleum gives the first flash of inflammable vapour, and at which the liquid permanently ignites; the vessel in which the experiment is made being a small,

round, flat-bottomed tin cup, about the shape and size of a two-ounce beaker, and heated in a water-bath. Whether or not traders generally will adopt this interpretation of the words of the Petroleum Act remains to be seen; it is to be hoped that they will, as it is clearly a step in the right direction. But let us hope that the public will ultimately be supplied with petroleum, of which it may be said that it is as safe as any of the old vegetable oils. There is no good reason why this should not be done, and, perhaps, no class of men can better aid in its accomplishment than consulting chemists, those for whose information chiefly these few sentences have been written. JOHN ATTFIELD.

Laboratory of the Pharmaceutical Society.

ABSTRACTS OF FOREIGN PAPERS.

BY

HENRY WATTS, B.A., F.R.S.,

AND

EDMUND J. MILLS, D.SC.

On some New Derivatives of Valerylene. *By* M. REBOUL.*

THE author has shown, in previous communications,† that valerylene, C_5H_8, forms with bromine a mono- and a di-bromide, and with bromhydric acid a mono- and a di-bromhydrate. This hydro-carbon is, in fact, capable of forming two series of compounds, the one composed of incomplete bodies, still capable of fixing H_2 or Br_2, or HBr, or their equivalents—in which, indeed, it plays the part of a diatomic radical; the other, composed of saturated bodies, in which it functions as a tetratomic radical.

The following table contains a list of the compounds of these two series hitherto obtained:

Diatomic series.‡

*Dibromide . . .	$C_5H_8Br_2$.
*Monobromhydrate	$C_5H_8 . HBr$.
Monochlorhydrate	$C_5H_8 . HCl$.
Mono-iodhydrate .	$C_5H_8 . HI$.
Mono-acetate . .	$C_5H_8\left\{\begin{matrix}H\\C_2H_3O_2\end{matrix}\right.$
Monohydrate . .	$C_5H_8\left\{\begin{matrix}H\\HO\end{matrix}\right.$

Tetratomic series.

*Tetrabromide	$C_5H_8Br_4$.
*Dibromobromhydrate .	$C_5H_8 . HBr . Br_2$.
*Dibromhydrate . . .	$C_5H_8 . H_2Br_2$.
Dichlorhydrate . . .	$C_5H_8 . H_2Cl_2$.
Diacetate	$C_5H_8\left\{\begin{matrix}H_2\\(C_2H_3O_2)_2\end{matrix}\right.$
Dihydrate, or amylenic pseudo-glycol . .	$C_5H_8\left\{\begin{matrix}H_2\\(HO)_2\end{matrix}\right.$

Chlorhydrates of Valerylene.—Valerylene unites readily with fuming chlorhydric acid, when heated with it to 100° in closed vessels. The reaction is complete in about eight hours; and if the vessel be then opened, and the upper coloured layer of liquid separated from the lower, then washed with alkaline water, dried, and subjected to fractional distillation, unaltered valerylene passes over first, then the monochlorhydrate at about 100°, then the dichlorhydrate at 150°—152°, and, lastly, a polymeric modification of valerylene.

The *monochlorhydrate*, $C_5H_8 . HCl$, is a mobile liquid, insoluble in and lighter than water, and having an odour like that of amylic chloride, but stronger and more unpleasant. It boils at about 100°, that is to say, 10 degrees higher than chlorhydrate of amylene, a difference exactly equal to that between the boiling-points of valerylene and amylene.

The *dichlorhydrate*, $C_5H_8 . H_2Cl_2$, is a liquid boiling at 150°—152°; heavier than water, and insoluble therein. It always retains small quantities of the monochlorhydrate.

Bromhydrates.—Previously described.

The *monobromhydrate* boils at about 115°; the *dibromhydrate* at about 180°, emitting fumes bromhydric acid.

Iodhydrates.—Iodhydric acid unites directly with valerylene when the two are agitated together, forming two iodhydrates. The *mono-iodhydrate*, $C_5H_8 . HI$, which is the only one that has been obtained pure, is a mobile liquid, heavier than water, and insoluble therein, boiling at 140°—142°, that is to say, 10 or 12 degrees higher than amylenic iodhydrate.

Acetates.—These compounds are obtained by heating the dibromhydrate to 100° for several hours in closed vessels with argentic acetate suspended in ether. The ethereal liquid, separated from argentic bromide and excess of argentic acetate, yields by distillation, after the excess of ether has been driven off:—1. A mixture of acetic acid and valerylenic mono-acetate, passing over, for the most part, at 120°—145°.—2. The diacetate, passing over at 200°—210°.

The diacetate is formed in the manner shown by the equation

$$C_5H_8 . H_2Br_2 + 2C_2H_3O_2Ag = 2BrAg + C_5H_8\left\{\begin{matrix}H_2\\(C_2H_3O_2)_2\end{matrix}\right.$$

The acetic acid and valerylenic mono-acetate are produced by a splitting up of the diacetate:

$$C_5H_8\left\{\begin{matrix}H_2\\(C_2H_3O_2)_2\end{matrix}\right. = \left.\begin{matrix}C_2H_3O_2\\H\end{matrix}\right\} + C_5H_8\left\{\begin{matrix}H\\C_2H_3O_2\end{matrix}\right.$$

Mono-acetate.—This compound, separated from the free acetic acid by washing with sodic carbonate and with water, then dried and distilled, is a mobile liquid, lighter than water, insoluble therein, and having a fragrant odour like that of pear-oil, but more pungent. Boils at 135°. When treated with pulverised solid potash (according to Wurtz's method), it yields *hydrate of valerylene*, as an aromatic liquid, lighter than water, insoluble therein, boiling at

* 'Comptes rendus,' lxiv, 285 (Feb. 6th, 1867).
† Ibid., lviii, 214; lx, 803. 'Bull. Soc. Chim.' [2], i, 363; iv, 203.
‡ The compounds marked with an asterisk have been previously described.

115°—120°. Sodium attacks this hydrate, eliminating hydrogen and forming a solid sodium-compound, which is reconverted by water into the pseudo-alcohol.

The *diacetate*—

$$C_5H_8 \left\{ \begin{array}{l} H_2 \\ (C_2H_3O_2)_2 \end{array} \right.$$

is a somewhat thick liquid, insoluble in water, and boiling at about 205°. It is saponified by potash, yielding potassic acetate and probably valerylenic dihydrate.

The two series of valerylene-compounds just enumerated are analogous to those of diallyl, C_6H_{10}, described by Wurtz. Nevertheless, diallyl does not appear to be a higher homologue of valerylene, inasmuch as its boiling-point is 15° or 18° too low; and although the differences between the boiling-points of the corresponding compounds of valerylene and diallyl are greater than that between the boiling-points of the hydro-carbons themselves, they are, nevertheless, not so great as those which should exist between true homologues.

On Di- and Amyl-Isopropyl. By SCHORLEMMER.*

The author has recently prepared di-isopropyl and amyl-isopropyl. Both bodies are easily obtained pure, because, like ordinary members of the marsh-gas series, they resist the action both of nitric and sulphuric acid. Di-isopropyl boils at 58°, it is easily attacked by chlorine in the cold, and the principal product of the reaction, the chloride

$$C_6H_{13}Cl,$$

which boils at 122°, exhibits the greatest resemblance to hexylic chloride. It differs, however, from di-propyl in its behaviour with chlorine in Hugo Müller's process. Amyl-isopropyl, which boils at 110°, yields, when submitted to the action of chlorine, a chloride which boils at 165°, smelling of oranges, and very similar to octylic chloride. The hydro-carbon is not attacked by iodic chloride in the cold, but a small quantity of chloride is formed on gently heating the mixture. Some higher chlorides also make their appearance. Schorlemmer employs the following formulæ, as representing the atom of iso-propyl, di-isopropyl, and amyl-isopropyl respectively:

$$\left\{ \begin{array}{l} CH_3 \\ CH \\ CH_3 \end{array} \right. \qquad \left\{ \begin{array}{l} C \left\{ \begin{array}{l} H \\ CH_3 \\ CH_3 \end{array} \right. \\ C \left\{ \begin{array}{l} CH_3 \\ CH_3 \\ H \end{array} \right. \end{array} \right. \qquad C \left\{ \begin{array}{l} H \\ CH_3 \\ CH_3 \\ C_5H_{11} \end{array} \right.$$

Isopropyl. Di-isopropyl. Amyl-isopropyl.

On Physostigmin. By O. HESSE.†

The author has renewed his valuable contributions to vegetable chemistry. He prepares physostigmin, an alkaloid discovered in the Calabar bean by Jobst and himself several years ago, by the following tolerably direct process:—The freshly prepared alcoholic extract of the bean is mixed with an excess of bicarbonate of sodium, and the solution placed in a tall cylinder and shaken with the proper quantity of ether. The ether is treated with very dilute sulphuric acid, whereby an almost colourless solution of physostigmin is formed; certain oily bodies, together with the odoriferous matter of the bean, remain in the ethereal mother-liquid. The acid solution is best completely freed from ether by partial evaporation under the air-pump; it must then be filtered through a wet filter, and again treated with ether and bicarbonate of sodium. On evaporating the ether to dryness a pure colourless product ought to be obtained. If, however, this is not the case, the operation last specified must be repeated. Pure physostigmin gives no coloration with dilute acetic acid.

The new alkaloid has the appearance of a dried colourless varnish; it becomes viscid at 40°, completely liquid at 45°, and decomposes on continued exposure to the temperature of 100°. It readily dissolves in alcohol, ether, benzol, bisulphide of carbon, and chloroform; less easily in cold water. The solution reacts strongly basic, even in presence of excess of carbonic acid, and neutralises acid completely. The salts are, like the free base, quite tasteless; they cannot easily be obtained in a pure state, because, though colourless at first, a red coloration sets in, showing that decomposition has occurred. The red colour may be removed, in the earlier stages of its formation, by means of sulphuretted hydrogen. A solution of soda or ammonia, in presence of air, induces the formation of an intense red colour with much greater facility than that of a dilute acid; chloride of lime acts at first in like manner, but the solution ultimately becomes colourless. Nitric and sulphuric acid give a yellow colour, which, in the latter case, soon changes to olive-green. The formula of physostigmin is

$$C_{15}H_{21}N_3O_2.$$

It forms a colourless and crystalline mercuro-iodide, which is insoluble in water, difficultly soluble in dilute hydrochloric acid, and easily dissolved by ether or alcohol. The formula of this compound is

$$C_{15}H_{21}N_3O_2.\ HI + HgI_2.$$

Crystallised physostigmin has already been described by Vée under the name of eserin.

On Itaconic Acid. By WILM.‡

The author gives an account of the results he obtained by treating itaconic acid with hydrated hypochlorous acid, according to Carius's method. In order to prepare itaconic acid, he first obtains citraconic acid by distilling citric acid which has been previously dried on the water-bath (a proceeding by which the quantity of product is materially increased). He finds that if citraconic acid be heated to 100° in open vessels, as is usually done, in order to prepare itaconic acid, the yield is relatively very small; but that, by heating a concentrated solution of citraconic acid to 120°-130° in sealed tubes, the transformation

* 'Zeitschr. Chem.,' x (Jan., 1867).
† 'Ann. Ch. Pharm.,' cxli (Jan., 1867).
‡ 'Ann. Ch. Pharm.,' cxli (Jan., 1867).

nto itaconic acid is certain and complete. In fact, the contents of the tubes solidify, on cooling, to a white crystalline mass, which is constituted entirely of the substance desired. The barium salt of this acid, contrary to the usual statement, is very difficultly soluble, so that the sodium salt was chosen, as it fulfilled the two necessary conditions—easy solubility and neutrality of reaction.

When concentrated solutions of itaconate of sodium and hypochlorous acid are mixed, a thorough decomposition ensues; carbonic acid and a body smelling like chloroform are set free, with considerable heat and intumescence. If, however, the quantity of itaconate be only very small, it undergoes scarcely any alteration under these circumstances. The process is best carried out as follows:—A 1 per cent. solution of hydrated hypochlorous acid is added, in small portions and with constant agitation, to a 2 per cent. solution of itaconate of sodium; the mixing vessel is immersed in ice-cold water, and kept away from the light. After five or ten minutes the smell of hypochlorous acid disappears, and is replaced by that of chloroform. When this point is reached, and if the liquid no longer bleaches indigo, the oxychloride of mercury is filtered off, sulphuretted hydrogen is passed through the filtrate, and the solution is shaken with ether. On distilling off the ether, the substance

$$C\ H\ ClO_5$$

was obtained, but not in a pure state, having already undergone a partial alteration. Wilm did not pay any further attention to this body, on account of the difficulty of purifying it; but usually evaporated the filtrate from the sulphide of mercury and expelled hydrochloric acid by repeated solution and evaporation. The final residue may be most expeditiously treated by the following process:—The mass is mixed with a quantity of sulphuric acid, rather more than equivalent to the weight of itaconic acid originally taken; the whole is then evaporated to dryness, exhausted with alcohol, and the alcohol removed by distillation. There remains a certain amount of a new acid, contaminated with very small quantities of chloride of sodium and hydrochloric acid. These impurities are readily removed by forming a lead salt, washing with water, and treatment with sulphuretted hydrogen.

The pure acid forms a glassy, amorphous mass; and, if it be slightly warmed, smells of honey. It dissolves easily both in water and alcohol, volatilises perceptibly with water at 100°, and decomposes with formation of a pyro-acid when heated alone. Two of its atoms of hydrogen are exchangeable for metal. The potassium and sodium salts do not crystallise. The acid prevents the precipitation of iron and copper by means of alkalies. The author gives the name *itatartaric acid* to this new body, thereby indicating that it is related at once to itaconic and tartaric acid.

The calcium salt

$$C_5H_6Ca_2O_6 + aq.^*$$

is very difficultly soluble in water—it forms white, crystalline masses. The barium salt is amorphous, easily soluble in water, insoluble in alcohol. It has the formula

$$C_5H_6Ba_2C_6.^\dagger$$

The zinc and copper salts are very similar, in general properties, to the barium salt. The neutral lead salt forms in beautiful (monoclinic) tabular crystals, which are difficultly soluble in water. They have the composition

$$C_5H_6Pb_2O_6.^\ddagger$$

The silver salt was not obtained in a pure state.

Itatartaric acid yields a pyro-acid at 170°, together with carbonic acid and water; some carbon is also separated. The reaction is approximately represented thus:

$$C_5H_8O_6 = CO_2 + H_2O + C_4H_6O_3.$$

The author proposes to term the new derivative *pyro-itaracemic acid*. It does not crystallise, is easily soluble in water and alcohol, volatilises with the vapour of water, and has an acid smell. It is monobasic. The barium salt has the formula

$$C_4H_5BaO_3 + aq.;$$

it is amorphous. The corresponding lead salt is as deliquescent as chloride of calcium. The silver salt is very unstable.

The Paris correspondence of this journal will be resumed in our next, and the arrangements that are now completed will insure the publication of a weekly letter.

The chemical papers recently read before the Royal Society of Edinburgh will be discussed in a series of articles commencing next week.

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

MEETINGS FOR THE FORTHCOMING WEEK.

April.		
Monday,	15.	Medical Society, 8 p.m.
Wednesday,	17.	Meteorological Society, 8 p.m.
		Geological Society, 8 p.m.
Thursday,	18.	Chemical Society, 8 p.m.

---

* Ca = 20.

† Ba = 68·5.   ‡ Pb = 103·6.

MAIN SERVICE FILTER.

This Filter, which is shown in section, consists of an external metal case, formed in two parts, *a* and *b*, fastened together by nuts and screws, I, I. The water to be filtered enters by the pipe F, passes first through the coarser filtering media A, then through the finer filter B, and flows off pure through the exit pipe C. By this means all the coarser impurities of the water are arrested by A, and consequently do not interfere with the action of B. These impurities accumulate in the cavity K, from whence they may be readily removed from time to time as may be requisite, by allowing the water to pass into the filter through M. This is instantly done by turning the three-way cock H, closing the exit tap C, and unscrewing the tap D; when the water entering the upper cavity by the pipe E will be forced in the reverse direction, through the coarser filtering media A, and carry off all impurities which that filter has been the means of arresting. This operation does not occupy more than a few seconds of time. These Filters are used by the Metropolitan Free Drinking Fountains Association, the General Post Office, London Hospital, Swansea Prison, and other large establishments.

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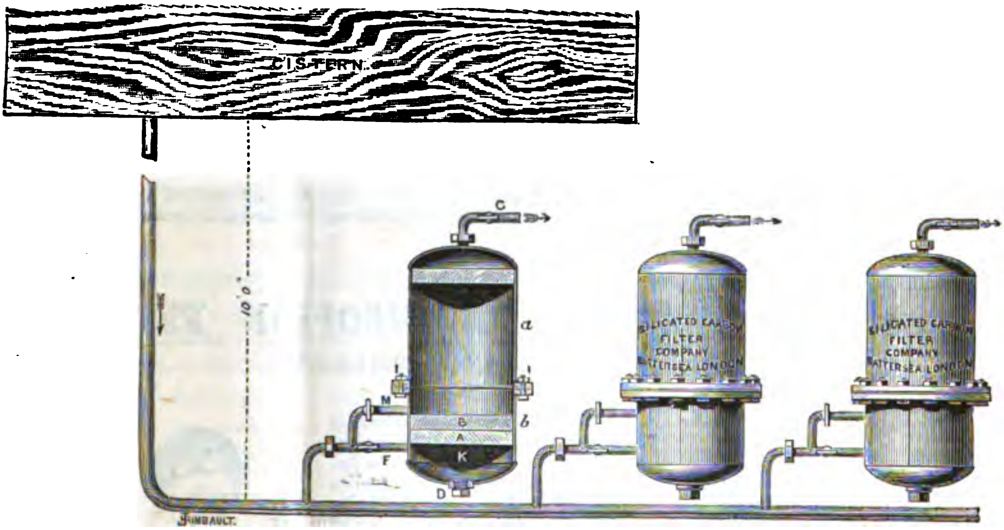

TESTIMONIAL.

"General Post Office, Medical Department; 23rd October, 1860.

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	Unfiltered.	Filtered.
Total solid contents of an Imperial Gallon	33½ gr.	8·7 gr.
Hardness, as determined by Clarke's Test	9 deg.	6 deg.
Earthy Carbonates deposited by boiling 1 Gallon	11· gr.	None.
Organic matter contained in an Imperial Gallon	3·8 gr.	0·6 gr.

The Unfiltered Water was of a greenish-yellow colour, and during evaporation gave out a most offensive odour, the residue being a dark brown mass of organic and saline impurities. When passed *once* through a *Silicated Carbon Filter* it became perfectly colourless, sweet, and drinkable. During evaporation not the slightest odour was perceptible, and the residue was quite white, and consisted of little more than chloride of sodium (common salt).

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THE LABORATORY:

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ORIGINAL COMMUNICATIONS.

MR. W. H. PERKIN ON NEW SALICYLE COMPOUNDS.

On the Hydrides of Benzosalicyle and Disalicyle. *By* W. H. PERKIN, *F.R.S.*

IN its chemical deportment the hydride of salicyle stands quite separate from all other aldehydes, its great peculiarity being the ease with which it forms metallic derivatives, this property being so marked that it was originally considered to be an acid. It is true that other aldehydes also form metallic compounds, as in the case of the hydride of cumyle, where we have the cumylide of potassium, $C_{10}H_{11}KO$, but these products do not bear any resemblance to the salicyle derivatives, being decomposed by water into the hydride and oxide of the metal.

The only view which appears to account for the peculiarities of the salicylic hydride is to regard it as possessing the double characters of an aldehyde and alcohol;* and this is quite reasonable if we consider salicylic acid as the glycollic acid of the series, thus—

$$\underbrace{\left(\begin{array}{c}CO'',HO\\ \left.\begin{array}{r}C_6H_4''\\ H\end{array}\right\}O\end{array}\right)}_{\text{Salicylic acid.}} \qquad \underbrace{\left(\begin{array}{c}CO'',\ H\\ \left.\begin{array}{r}C_6H_4''\\ H\end{array}\right\}O\end{array}\right)}_{\text{Hydride of salicyle.}}$$

The metallic derivatives would then be written thus:

$$\left(\begin{array}{c}CO'',MO\\ \left.\begin{array}{r}C_6H_4''\\ M\end{array}\right\}O\end{array}\right) \qquad \left(\begin{array}{c}CO'',\ H\\ \left.\begin{array}{r}C_6H_4''\\ M\end{array}\right\}O\end{array}\right)$$

A considerable number of compounds have been produced by treating the hydride of salicyle with the chlorides of the acid radicles. These bodies are regarded as the hydride of salicyle, in which the typical aldehydic hydrogen is replaced by an acid radicle. Thus, in Gerhardt's 'Traité de Chimie' the formation of the body known as parasalicyle or salicylite of benzoile is thus expressed:

$$\underbrace{\left.\begin{array}{r}C_7H_5O\\ Cl\end{array}\right\}}_{\text{Chloride of benzoile.}} + \underbrace{\left.\begin{array}{r}C_7H_5O_2\\ H\end{array}\right\}}_{\text{Hydride of salicyle.}} = \left.\begin{array}{r}H\\ Cl\end{array}\right\} + \underbrace{\left.\begin{array}{r}C_7H_5O_2\\ C_7H_5O\end{array}\right\}}_{\text{Salicylite of benzoile.}}$$

Thus making it appear like an acetone with a molecule of an alcohol radicle, replaced by an acid radicle—in fact, a compound acid radicle.

Viewing the hydride of salicyle as an aldehyde and an alcohol, it appeared to me more reasonable to believe that the hydrogen which was replaced by the acid radicle was alcoholic and not aldehydic. I therefore thought it would be well to examine one of these derivatives more fully, and for this purpose I endeavoured to prepare a quantity of the substance mentioned above—the salicylite of benzoile.

For this purpose I employed the method described by Cahours; but instead of using the hydride of salicyle, I employed the anhydrous sodium derivative (salicylite of sodium). The following were my results:

Several grammes of the anhydrous sodium derivative in fine powder were gradually added to an equivalent quantity of chloride of benzoile, a considerable amount of heat was evolved, and the mass, on being well stirred, gradually became transparent and of an amber colour. On the addition of water to this product chloride of sodium dissolved out, leaving a very thick oil. This was constantly agitated with water, and then carbonate of sodium to remove any chloride of benzoile that might have been in excess. After being separated from the water it was placed in a retort; and on the application of heat scarcely anything came over within the range of the mercurial thermometer; but on raising the temperature still higher the product almost entirely distilled as a pale yellow oil. Two combustions of this substance in oxygen gave the following numbers:

I. ·2087 of substance gave—
·5678 of CO_2, and
·0875 of H_2O.

II. ·1947 of substance gave—
·5303 of CO_2, and
·0811 of H_2O.

These numbers give percentages which accord well with the formula—

$$H, C_7H_4(C_7H_5O)O_2 = C_{14}H_{10}O_3,$$

as the following comparisons will show:

	Theory.		Experiment.	
			I.	II.
C_{14}	168	74·33	74·19	74·28
H_{10}	10	4·42	4·65	4·62
O_3	48	21·25	—	—
	226	100·00		

This substance I propose to call the *hydride of benzosalicyle*. It possesses both the properties of an aldehyde and a benzoate, as will be seen from its reaction, and this will be easily understood from the following equation:

$$\underbrace{\left(\begin{array}{c}CO'',\ H\\ \left.\begin{array}{r}C_6H_4''\\ Na\end{array}\right\}O\end{array}\right)}_{\text{Hydride of sodium salicyle (salicylite of sodium).}} + Bz\,Cl = \underbrace{\left(\begin{array}{c}CO'',H\\ \left.\begin{array}{r}C_6H_4''\\ Bz\end{array}\right\}O\end{array}\right)}_{\text{Hydride of benzosalicyle.}} + Na\,Cl.$$

The hydride of benzosalicyle, when cold, is a

* By the expression "alcohol" in this paper I simply mean the hydrate of hydrocarbon radicle, as the hydrate of phenyl, etc.

thick oil, with very little odour. It is heavier than water, and apparently insoluble in that menstruum, but very soluble in alcohol and ether. It distils at a temperature above the range of the mercurial thermometer.

As stated above, it is an aldehyde, and combines with the bisulphites; when agitated with bisulphite of sodium it gradually thickens, and in the course of half an hour is entirely converted into a white powder. This compound, on being heated, splits up the hydride of benzosalicyle, separating as an oil. With the bisulphites of potassium and ammonium, crystalline derivatives are produced.

When heated with an alcohol solution of the hydrate of potassium, the hydride of benzosalicle decomposes, yielding benzoic acid and hydride of salicyle in the same manner as the benzoate of phenyl yields benzoic acid and the hydrate of phenyl under the same circumstances; thus—

$$\underbrace{\left(\left.\begin{array}{c}CO'',H\\ C_6H_4''\\ Bz\end{array}\right\}O\right)}_{\text{Hydride of benzo-salicyle.}}+H_2O=\underbrace{\left(\left.\begin{array}{c}CO'',H\\ C_6H_4''\\ H\end{array}\right\}O\right)}_{\text{Hydride of salicyle.}}+\underbrace{\left.\begin{array}{c}H\\ Bz\end{array}\right\}O}_{\text{Benzoic acid.}}$$

$$\underbrace{\left.\begin{array}{c}C_6H_5\\ Bz\end{array}\right\}O}_{\text{Benzoate of phenyl.}}+H_2O=\underbrace{\left.\begin{array}{c}C_6H_5\\ H\end{array}\right\}O}_{\text{Hydrate of phenyl.}}+\underbrace{\left.\begin{array}{c}H\\ Bz\end{array}\right\}O}_{\text{Benzoic acid.}}$$

This hydride is but slowly acted upon by nitric acid. When heated in a sealed tube, with alcoholic ammonia, it yields a brown sticky product, but which contains a crystalline body.

The product obtained by Ettling and Cahours, and described as parasalicyle or salicylite of benzoile, although having the same composition as the substance I have described above, bears no relation to it whatever. Their derivative is a hard solid, crystallising in needles, and fusing at 130°C.,* and is not decomposed even by boiling with an alcoholic solution of the hydrate of potassium. For a long time I was unable to account for the great difference in properties, both chemical and physical, especially as both these substances may be prepared by processes which at first sight appear virtually the same.

On mixing the hydride of salicyle with about half its weight of chloride of acetyl, it rapidly changes colour, and in the course of a short time hydrochloric acid is abundantly given off, the liquid at the same time assuming a dark olive hue. On cooling, the product of this reaction crystallises as a mass of hard prisms. It is purified by being pressed between bibulous paper, and then recrystallised two or three times from alcohol. Two combustions of this product in oxygen gave the following numbers:

I. ·2654 of substance gave—
·7231 of CO_2, and
·1098 of H_2O.

II. ·1899 of substance gave—
·5163 of CO_2, and
·0801 of H_2O.

These numbers give percentages agreeing well with those required by the formula—

$$C_{14}H_{10}O_3,$$

as the following comparisons will show:

	Theory.	Experiment. I.	Experiment. II.
Carbon .	74·33	74·3	74·14
Hydrogen .	4·42	4·59	4·68

This substance has, then, the same composition as the hydride of benzosalicyle, but from its formation it is evident that it cannot be a benzoile derivative nor from its composition can it be an acetyl derivative, as the latter would contain 65·85 p. c. of carbon and 4·78 p. c. of hydrogen.

On comparing this body with some of that known as parasalicyle or salicylite of benzoile (and which had been prepared by Ettling's process) I found them identical both in chemical properties and fusing-point.

The formation of this body can only be accounted for by assuming that it is derived from two equivalents of the hydride of salicyle by the separation of an equivalent of water. I therefore propose to call it the *hydride of disalicyle*. Its formation by means of chloride of acetyl is thus explained:

$$2\underbrace{\left(\left.\begin{array}{c}CO'',H\\ C_6H_4''\\ H\end{array}\right\}O\right)}_{\text{Hydride of salicyle.}}+AcCl=\underbrace{\left(\left.\begin{array}{c}CO'',H\\ C_6H_4''\\ C_6H_4''\\ CO'',H\end{array}\right\}O\right)}_{\text{Hydride of disalicyle.}}$$

$$+\left.\begin{array}{c}Ac\\ H\end{array}\right\}O+HCl.$$

By substituting chloride of benzoile in this equation for that of acetyl, it is easily understood how Cahours obtained this product. I find that it is also produced by the action of chloride of succinyle on hydride of salicyle.

It is therefore evident that both the name of

* The fusing point given by Gerhardt is 127°, but in all my determinations it has come to 130—131°.

this substance and the equation expressing its formation as given in Gerhardt's 'Traité de Chimie' are erroneous, the substance not being a benzoile derivative.

I have not at present succeeded in combining the hydride of disalicyle with bisulphites; this may, perhaps, be owing to its insolubility. When heated with chloride of acetyl in a sealed tube to 150° C., it yields an oil which appears to contain both acetyl and chlorine, but which cannot be distilled without decomposition; in its formation no hydrochloric acid is evolved. When boiled with potash, hydride of salicyle is produced.

We have now the following bodies belonging to the aromatic series all possessing the same composition:

$$\text{Benzoic anhydride} \left\{ \begin{matrix} C_7H_5O \\ C_7H_5O \end{matrix} \right\} O = C_{14}H_{10}O_3.$$

$$\left.\begin{matrix}\text{Hydride of} \\ \text{benzosalicyle}\end{matrix}\right\} H, C_7H_4(C_7H_5O)O_2 = C_{14}H_{10}O_3.$$

$$\begin{matrix}\text{Hydride of dis-} \\ \text{alicyle}\end{matrix} \left\{ \begin{matrix} H, C_7H_4O \\ H, C_7H_4O \end{matrix} \right\} O = C_{14}H_{10}O_3.$$

DR. E. J. MILLS ON ISOMERISM.

On Isomerism. By EDMUND J. MILLS, *D.Sc., F.C.S.* *Part II.**

THE problem of isomerism can be treated in one of two ways. It may either be made to receive a spurious solution from *à priori* materialism; or it may be submitted to a purely experimental elucidation. The former alternative involves the hitherto unrealised conception of an absolute limit, and the contradiction of the analogy of nature, which nowhere presents us with indivisibles; the latter is the process which is not only consistent with modern philosophical teaching, but has long been recognised as the only legitimate track for scientific ratiocination to follow.

Stated in its broadest terms, the fundamental question is, how to account for substances which have the same percentage composition but different properties. We may, for the present, exclude polymerism and, perhaps, allotropy; for, so far as our existing knowledge extends, polymerism appears to be merely a special case of chemical combination, and the obscure phenomenon of allotropy is not yet sufficiently mature for discussion. But "physical isomerism," as it exhibits no salient feature whereby it can be distinguished, in my own opinion, from isomerism of the ordinary kind, ought to be taken as forming part of the general problem.

* See p. 4 (April 6).

In the first place, it is not difficult to ascertain that isomerism is more immediately concerned with force than with matter. Thus, for example, when toluol is boiled with hydric nitrate, α and β hydric nitro-benzoate are formed. These bodies are attacked by aqueous hydric iodide, under similar circumstances in the two cases, *at different temperatures;* the result being that the nitryl (NO_2) of each is changed into amide (NH_2).

$$\underset{\alpha\ \beta \text{ hydric nitrobenzoate}}{C_7H_5O_2 \,.\, NO_2 + 6HI} =$$

$$\underset{\alpha\ \beta \text{ hydric amido-benzoate.}}{C_7H_5O_2 \,.\, NH_2 + 2H_2O + 3I_2}$$

Hence it follows that the nitryl of α is not the same with the nitryl of β. But both species were derived from the primitive and necessarily homogeneous nitryl of the hydric nitrate

$$HO.NO_2;$$

whence it is obvious that their dissimilarity was conferred at the moment of chemical action, and is, consequently, a question of the disposal of the various energies which were present at such action. Consider, again, the instance of α and β nitraniline. A nitraniline is formed by the action of ammonic hydric sulphide on dinitro-benzol, which last is obtained by nitrating nitro-benzol; β nitraniline is produced by the successive action of hydric acetate, hydric nitrate, and potassic hydrate on aniline, itself formed also from nitro-benzol by reduction. In the course of these changes, which are much more numerous in the latter than in the former case, the amount of positive work done in the genesis of β nitraniline is almost evidently greater than in that of α nitraniline; and I have proved, as in the preceding example, that the nitryl of α is attacked at a much lower temperature by aqueous hydric iodide than the nitryl of β. It is yet too early to infer that the attack-point or fusion-point of a nitro-compound is higher in proportion to the positive energy accumulated upon it when forming; but it is sufficiently clear that the same conclusion may be drawn as in the case of the hydric nitro-benzoates. Again, when furfurine and hydro-benzamide are boiled with aqueous potassic hydrate, they change wholly into their respective isomers furfuramide and amarine. Moreover, as Duffy pointed out* long since, certain fats do not reassume their primitive melting-point after once fusing. A parallel instance occurs in α and γ hydric nitro-benzoate,† both of which are partially or entirely modified into the δ com-

* 'Chem. Soc. Quart. Journ.,' v, 179.
† 'Chem. Soc. Journ.' [2], iv, 363.

pound by mere heating. The transformation of liquid into solid styrol is a familiar illustration, and remarkable from its great analogy to the change of ordinary into red phosphorus. These and many like examples show what is, I believe, true for every case, that isomerism must derive its ultimate explanation from the science of energy.

In the second place, isomerism is a question of degree—a matter of greater or less. The chief differentiation among the members of a given isomeric group may consist in an alteration of the fusion-point from a lower to a higher temperature; thus, the four hydric nitrobenzoates fuse respectively at (α) 128°, (γ) 136°, (δ) 141,° (β) 238°: or, the principal criterion may be their action on polarised light; as in the common instance of the three hydric tartrates, of which one is dextro-rotatory, another neutral, and the third lævo-rotatory. The isomers of turpentine afford a good additional instance of this last kind. Probably, however, no good case has been established in which only one discriminating character exists; it being usual to find, with one principal difference, several of a subordinate kind. Thus, α nitraniline fuses at 110° and β nitraniline at 141°; but, in addition, α nitraniline forms with hydric chloride a compound which stands dilution with water, whereas β nitraniline hydric chloride decomposes on dilution; β nitraniline is brittle, has no taste, and is moderately iridescent—α nitraniline is comparatively tough, has a sweet taste, and exhibits only traces of iridescence. The sugars might also be adduced here. It is very unlikely, indeed, that the individuals of any group of even "physical" isomers have really but certain physical difference; it is much more in accordance with analogy that they should also be distinguishable by chemical reaction, though it may very well be true that no appropriate reagents have yet been discovered in special instances. A problem of this kind has been worked out by Greville Williams* with his customary skill. Forces are, as it were, *affiliated* in the generality of circumstances; so that, if any one relationship suffer a disturbance, all the rest are forthwith affected.

Thirdly, if it be admitted that isomerism is a question which relates especially to energy, and is also a matter of greater or less (not of absolutes), it will readily be understood that three or more isomers of one genus can be arranged in the order of their relation to some suitable function, in such a manner that a given substance shall fuse (say) higher than one written above it, but lower than that whose name succeeds it; so that a series may be made, similar to an electric series in which a certain material is, when properly excited, positive to those bodies which rank above it, and negative to those which are arranged below it in the scale. Only that, in the cases we are now considering, substances are not excited by friction, but by the application of heat, a polarised ray, etc. The remotest possible individuals in such a list would be denoted respectively by the positive and negative sign, and the list itself would be recognised as one having reference to energy considered in its *polar* aspect. I may adduce the following illustrative series:

Sugars* — $C_6H_{12}O_6$
(Rotatory power.)

+

Melitose	+	102
Dextroglucose	+	55
Eucalyn	+	50
Inosite		0
Sorbin	—	47
Lævoglucose	—	106*

—

Isomers must be considered as containing radicles upon which differences with respect to force have been permanently impressed. This is so obvious a consequence of what has been shown in the two nitranilines and two of the hydric nitro-benzoates that I will merely state it here, with the addition of one confirmatory argument in answer to a possible objection. It might be urged that bodies cannot be characterised as thus positive or negative in the free state, which is commonly admitted to be a condition of molecular neutrality and of radicle satisfaction. To this it may be replied that the neutrality alluded to, in other words the "combination of atomicities," is one of pure number only, so far as I can attach any satisfactory meaning to the expression; and that the permanent induction of opposite properties with respect to energy has been substantially admitted by every one who has employed the terms "acid" and "base."

The idea of chemical polarity may be said to have been founded by Avogadro, a philosopher whose treatises scarcely meet with the attention they deserve from living chemists. In his remarkable essay on "Acidity and Alkalinity"† he states the doctrine clearly and at length; asserting, for instance, that "of two substances which combine, *one always plays the part of acid and the other that of alkali*; and it is this antagonism which constitutes tendency to combination, or *affinity* properly so called" (p. 144). He also expresses his opinion that all chemical

* 'Proc. Roy. Soc.,' 1864, 303.

* A sugar may be compared to a magnetic coil, in respect to its action on light.

† 'Journ. de Phys.,' 1809.

bodies whatsoever can be written in a series, the extreme limits of which would be occupied by the most acid and the most alkaline respectively; but that "acidity" and "alkalinity" are merely relative terms, having only an absolute meaning with respect to some compound of strictly intermediate properties. With such philosophical breadth of view he anticipated the notion of series which, long afterwards and in a narrower form, occurred to the distinguished Gerhardt; and, in addition, left behind him a healthy germ of ideas, which has already borne some fruit in the speculations of Graham, Laurent, and Brodie. I do not doubt that, if Avogadro had been at the command of science some twenty years later, a solution, on polar principles, of this problem of isomerism would have at once presented itself to his mind.

Discussions as to the real nature of matter have prevailed since the remotest times of scientific inquiry. One of the most interesting questions which has been raised is, whether all matter consist of a single element or of several—akin, undoubtedly, to the problem of the One and the Many of pure philosophy. Not a few of the early Greek physicists were in favour of the singleness. In a period much nearer to our own time, the alchemists must essentially have adopted the same view; and it is not without support from living writers on isomerism. These last, indeed, speak with much reserve, even in the presence of so many accumulated facts which might be alleged as in favour of the unitary hypothesis; those who have read the history of The Cosmopolite with scepticism may therefore listen to more modern chemists with confidence. Dumas, at the close of one of his most important memoirs,* makes the following remarks. "The compounds which the three natural kingdoms supply for our study are reduced by analysis to a certain number of radicles which can be classified into natural families. The characters of these families, whether we refer to the radicles of mineral or of organic chemistry, exhibit indisputable analogy. But the radicles of mineral chemistry differ in this respect from those of organic chemistry, that, if they are compound, they at least have so great a stability that known forces cannot effect their decomposition. Nevertheless this mutual analogy, which the radicles of mineral and organic chemistry display, certainly authorises us to inquire whether the former are, like the latter, compound bodies. . . . All the equivalents of the simple bodies or radicles of mineral chemistry appear to be multiples of a certain unit, equal to 0·5 or 0·25 the weight of the equivalent of hydrogen. When we arrange in the same series the equivalents of the radicles of the same family (either mineral or organic), the first term determines the chemical character of all the constituent members. Calling a the first term of the progression and d its increment, we may say that in every equivalent

$$a + nd,$$

it is a that bestows the fundamental character and fixes the genus, while nd only determines the particular term in the progression and decides the species." The elements are thus classified into a few natural families, and the equivalents in each are written in order, from the lowest (a) to the highest; it then appears that an arithmetical progression exists—in other words, that the law of multiple proportions is true for the equivalent numbers. So that, for six natural families, the *maximum* number of necessary prime factors is twelve. The hypothesis that all equivalents are multiples of 0·25 that of hydrogen is quite distinct from this; it tends to the inference that all the elements are polymers of some simpler substance. Of this supposition Berthelot* very truly says, "The specific heats of solid or liquid polymers (I mean those which have been actually observed in organic chemistry) are nearly the same for equal weights; that is, they vary directly with the equivalents of the polymers. On the contrary, in accordance with the law of Dulong and Petit, the specific heats of the elements are inversely as their equivalents, instead of being the same for equal weights of all bodies, as would appear to result from the preceding law." Further on,† the same chemist developes an hypothesis of his own. "In a word, it does not seem necessary that all these systems should represent multiples of the same ponderal elementary unit. Let us conceive *à priori* such systems proffering, in their mutual relationship, the connection which exists, for example, between the different roots of an equation; or, more generally, between the multiple values of the same definite function. Fundamental matter will represent the function, and the simple bodies will correspond to its determinate values." The writer adds that, on this theory, a (supposed) simple body might be destroyed, but not decomposed; and that several systems of simple bodies might be produced from the same element. Finally, he alludes to his conception of "matter as fundamentally one, though multiform in its appearances, and such that none of its manifestations can be regarded as the

* 'Ann. Ch. Phys.' [3] lv, 209, 211.

* 'Sur l'Isomérie,' pp. 163, 164. † Ibid., pp. 165, 166.

necessary starting-point of all the others, etc."*

These observations make it clear that the authors thought it possible that all forms of matter might be in reality one. It might, indeed, have been inferred, from the fact that the elements differ in no general respect from ordinary compounds—a circumstance which renders their usually separate classification a very illogical proceeding—and from the obviously almost serial gradation which exists between them when properly arranged, as well as from their mutual similarities being more remarkable than their differences, that they might all be very well composed of only one or two primitive substances. But this special question relates rather to the results classified under the name of isomerism than to the causes of isomerism itself; and we must be careful not to confound these two subjects, which are perfectly distinct. It may, I think, be securely said that, quite independently of the phenomena of isomerism, we have no sufficient grounds to admit that matter is composed of any large number of prime factors; and the logical position is, of course, to accept on more than is proved. But, even if our world actually consisted, in ultimate analysis, of many absolutely different materials, it would still be competent to the chemical, luminous, electric, or any other form of energy, acting in concert or alone, with this or that intensity, on a given simple substance, to produce from that single source as many *appearances* of essential difference as are presented to us by ordinary chemical bodies.

I regard isomerism as brought about by the polar distribution of various forces, two at least taken together, in such a manner that radicles, and therefore substances in the free state, acquire, without disturbance of their composition, the permanent impression of opposite functions. We ought first, therefore, to inquire into the qualities of radicles with respect to various forces; and, secondly, into the mode whereby those qualities were originally induced. The problem of isomerism may be stated as follows:—*Under what conditions of action do forces effect a fixed alteration in one or more functions of radicles?* Isomerism, indeed, is finally resolved into a particular case of the action of those very forms of energy which preside over the formation of all substances whatsoever.

It was not altogether without reason that Herakleitus, the fundamental conception of whose philosophy seems to have been a self-infolded circuit or series, compared all things to a river, which traverses the land, is involved in the ocean, and thence distils upon its primitive source; whose obvious character may be for ever the same, while its minute phenomena are subject to eternal change. For the just aim of science is at generic, not at specific, acquirements; in proportion to our real advance we must desert individual mutations for the permanence of type and series.

* For another hypothesis in the same direction, see Graham 'Phil. Mag.' [4], xxvii, 81.

LABORATORY NOTES.

Preparation of pure Nitrite of Potash.

Having recently had occasion to prepare pure nitrite of potash, I have tried various methods, and find the following to be the easiest, and also to yield a perfectly pure product. I first prepare nitrite of amyl by saturating amylic alcohol with nitrous acid evolved from arsenious and nitric acids; the crude product so obtained is washed with aqueous caustic potash, dried and distilled, rejecting everything which comes over above 100°. For every five parts of this ether, I dissolve two of caustic potash in alcohol of about 80 per cent. (If methylated spirit is used, it should be distilled from caustic potash previously.) This solution is then mixed with the nitrite of amyl and the mixture gently warmed for about an hour; an abundant precipitate of pure nitrite of potash is formed. The liquid is allowed to cool, the nitrite filtered off and washed with alcohol, pressed between folds of blotting-paper and dried in the water-bath. The chief points needing attention in the foregoing preparation are not to use excess of caustic potash in decomposing the ether, and to use freshly prepared solution of potash in alcohol. The above process doubtless sounds complicated, but I know of no other which furnishes *chemically pure* nitrite with so little trouble.

E. T. Chapman.

On the Action of the Alkaline Chlorates on Ferrous Salts.

A considerable quantity of hydrated peroxide of iron being required, I endeavoured to procure it by boiling sulphate of iron, carbonate of sodium, and chlorate of potassium:

$$6Fe_2SO_4 + 6Na_2CO_3 + 2H_2O + KClO_3$$
$$= 3Fe_4O_3, 2H_2O + 6Na_2SO_4 + KCl + 6CO_2.$$

Although a slight excess of the chlorate had been used, I found that instead of peroxide the hydrated magnetic oxide was thrown down.

In more carefully conducted experiments afterwards performed with pure materials, I found the following phenomena were evinced. In these cases a solution of ammonia was used in place of the carbonate of sodium.

(1) If the chlorate and ferrous salt are boiled together a ferric salt is produced. The same reaction is, of course, evinced if the solutions are acidulated.

In the first case a basic salt is thrown down, from the deficiency of acid present, but the oxidation is complete.

(2) If a small quantity of ammonia be added (not necessarily 12 equivalents), the deposition of the magnetic oxide is at once determined, nor will any amount of boiling bring about any further reaction between the iron oxide and the chlorate.

As regards the decomposition, a precipitate of magnetic oxide agreeing nearly with the formula $Fe_6O_4 3H_2O$ was procured, and the chlorine from 2·45 grains of chlorate of potassium was proportioned as follows:

Chlorine present as chlorides	·497
„ combined with oxygen	·212
Total Cl. . . .	·709 (Theory. ·710)

The oxygen, combined with part of the chlorine, was determined by a standard iron solution, but it seemed to be variable and to depend upon the amount of boiling and other circumstances to which the mixture had been exposed; but in no case was a perchlorate formed, as might be imagined. The reaction under the circumstances mentioned in the second experiment seemed to consist only of a partial decomposition of the chlorate, as some of this salt was remaining in solution. It is curious that, as partial decomposition was determined by the relative proportion of base to acids, that a similar decomposition was not got on boiling chlorate of potassium and neutral sulphate of iron together—the result being a mixture with an abnormal basicity. A third experiment will be tried to determine the point at which this reaction is produced.

C. R. C. Tichborne.

Apothecaries' Hall of Ireland.

EDITORIAL NOTES.

THE BRITISH MUSEUM READING ROOM.

The British Museum Reading Room may in some sort be considered the literary home of the London student. Here he may come daily and sit at his ease and read up any subject he chooses, from Assyrian weights and measures to comic literature. For every worker with the pen there is warmth in winter, pleasant coolness in summer, light, ease, and comfort at all times; the rarest of manuscripts and the most expensive and scarce books are brought to him by civil attendants, and if his researches do not carry him very deeply into the subject upon which he is working, he has within reach of his hand a magnificent library of reference. It is of this portion of the treasures of Great Russell Street that we wish more particularly to speak. The most cursory examination of the shelves devoted to books of reference on chemistry and the allied sciences will show a very lamentable deficiency in works that are absolutely necessary to the chemical student of the present day. By the term chemical student we do not mean so much those who are about to make our great science their life-study, but rather the ordinary student who is reading up for his degree in arts or medicine, or the aspirant to any of those numerous government appointments which necessitate a more or less intimate knowledge of the principles and practice of chemistry. A list of some of the books on the shelves will show that our complaints are not ill-founded.

Elements of Chemistry.—Graham, 1842 and 1850-58; Turner, 1847; Brande, 1848; Stockhardt, 1852; Berzelius, 1829-33.

Dictionaries.—Aikin, 1807; Brande, 1853; Nicholson, 1795; Klaproth, 1810.

Miscellaneous.—Donovan, 1832; Prout, 1855; Liebig's 'Agricultural Chemistry,' 1847; Liebig's 'Animal Chemistry,' 1846; Noad's 'Analysis,' 1848.

On the other hand, scientific periodical literature, which is really of little or no use to the student, is most diligently looked after. The 'Philosophical Transactions,' the two Philosophical Magazines, the 'Quarterly Journal of Science,' the 'British Association Reports,' the French '*Comptes Rendus*,' and many other publications of a similar nature, are placed upon the shelves almost as soon as they are published. In applied chemistry we have the last edition of Ure's excellent dictionary edited by Mr. Robert Hunt, and Watts and Richardson's 'Chemical Technology.' The Reports of the Juries for the Exhibition of 1862 have not yet made their appearance, although five years nearly have elapsed since their publication. The 'Proceedings of the Royal and Chemical Societies' ought also surely be upon the shelves.

Will the principal librarian and his able colleagues take it in good part if we point out a few of the books which might well supplant some of the antique volumes at present placed before the puzzled student as books of reference? First and foremost on the list will stand the last edition of Miller's 'Elements.' The works of Fownes, Hofmann, Williamson, Galloway, Fresenius, Frankland, Bloxam, and Roscoe, are all simply *desiderata*. Watts's 'Dictionary of Chemistry,' now in course of publication, could hardly be dispensed with, while in foreign literature Gmelin, Gerhardt, Laurent, Kekulé, Berthelot, and Wurtz, are quite as necessary to the student as the works already cited.

We trust most sincerely that the officials of

the British Museum Library, of whose courtesy and painstaking kindness we have personally experienced so many instances, will not think that the remarks we have made have been prompted by a captious or fault-finding spirit. We are sure that they will agree with us that to place as many facilities as possible in the way of the hardworking student is simply to confer a benefit on the community at large. Indeed, it is the principle that they themselves have taught so practically. These gentlemen, with their large and intelligent views, have given us the noblest students' library in the world, and every literary man who has entered the glass doors of the largest reading-room ever built has found ample cause to bestow on them unstintingly and sincerely the high meed of praise to which their successful exertions entitle them. If, therefore, we have taken upon ourselves to point out a little dusty corner in the library, we trust they will give us credit for no intention other than that of wishing to see the British Museum Library of Reference kept in a state of the highest efficiency.

INTERNATIONAL BANQUET AT PARIS.

The chemists and physicists of France are determined that their foreign brethren who have been attracted by the Exhibition shall not quit Paris with inadequate notions of French hospitality. Many of the eminent men who were our guests in 1862 have eagerly seized the opportunity of showing us how gracefully they can perform the duties of hosts, and the dinner at the Café Corazza on Monday evening proved a splendid sequel to the memorable banquet at the Trafalgar.

Our Paris correspondent, who was one of the entertainers, has sent us the following interesting particulars respecting this great gathering of scientific men:

The Hosts.—Balard, Barral, Ed. Becquerel, Berthelot, Bourtron, Boussingault, Bouys, Bussy, Caventon, Chancourtois, Chevreul, Cloez, Daguin, Daubraie, Debray, De Milly, Descloizeau, Deville, Dorveau, Dubrunfaut, Dumas, Foucault, Fourcade, Fremy, Friedel, A. Girard, C. Girard, Gobelet, Grandeau, Karmarsch, Kuhlmann, Ladenburg, Lamy, Le Blanc, Lecanu, Marguerite, Mengon, Mial, Motard, Nicklès, Oppenheim, Payen, Peligot, E. Pelouze, Poggiale, Pouillet, Reboul, Regnault, Salet, Serbat, Baron Thénard, Thénard, Wurtz. (Professor Deville could not be present at the dinner in consequence of a severe domestic affliction, and M. Chevreul was unfortunately too ill to take part in the festivities.)

The Guests.—Andrarjeff, Bauer, Beck (Copenhagen), Beck (Wurtemburg), Birnbaum, Bolley, Crace Calvert, Chandelon, Danielsen, De Cabral, De la Rive, De la Rue, Dove, Fehling, Frankland, Fritzsche, Hansenclever, Hofmann, Sterry Hunt, Jacobi, Sir Robert Kane, Kekulé, Liebig, Magnus, Martius, McLeod, Mendelejeff, Hugo Müller, Odling, Olshausen, Playfair, D. S. Price, Richter, Roscoe, Schrötter, Siemems, Laurence Smith, Steinbeiss, Stoeltzel, Tyndall, Varrentrapp, Count Villa-Mayor, Vogel, Wagener, Wanklyn, Wartmann, Wheatstone, Wiedemann, Zinin.

M. Dumas, the President, proposed as a toast "The English chemists and physicists," and stated that their Continental brethren would never forget their hospitality in 1862.

Dr. Lyon Playfair replied, and gave "The French chemists and physicists."

M. Balard then invited the company to drink to the health of Liebig, as the representative of German science, a great writer, and a great chemist.

Baron Liebig, in responding to the toast, referred to his first visit to Paris in 1823. Though he was then but nineteen he was received in the kindest manner by Gay Lussac and Thénard, and by the former his first paper, *On Fulminates*, was submitted to the Academy. French chemists had been his masters, and he had always found them his friends. Liebig concluded his speech by proposing, as a solemn toast, "The memory of Gay Lussac and Thénard."

Dr. Hofmann then proposed the health of Chevreul as President of the Academy.

M. Dumas answered this toast by reading a letter from his friend, explaining his unavoidable absence and expressing his warm feelings towards foreign chemists. Before sitting down M. Dumas toasted the rising generation of chemists, and announced that the Dinner Committee had secured the rooms in which they were seated for the use of foreign chemists and physicists during the Exhibition.

As many of our readers will visit Paris while the Exhibition is open, we have much pleasure in calling their attention to this generous provision of the French chemists. The rooms will be open every Monday, Wednesday, and Friday evening, to every foreign chemist or physicist who may present his card.

The address is Douis' Café Corazza, Palais Royal.

We are glad to find that the London Chemical Society was so well represented at the dinner. The President, two Vice-presidents, the Secretary, the Foreign Secretary, and several Fellows, were among the guests.

LITERATURE.

KÜHNE'S PHYSIOLOGICAL CHEMISTRY.

Lehrbuch der Physiologischen Chemie von Dr. W. Kühne. Lief. 1, 2. Leipzig, 1866.

"I AM no chemist; you are no physiologist," were the words, we believe, made use of by Moleschott in one of his spirited polemics against Liebig. They were meant to convey the idea that the chemist is as much out of his province in attempting to solve physiological problems as is the physiologist when he offers contributions to the science of pure chemistry. The sentiment, however, laying aside the temptations offered by the epigrammatic form in which it is expressed, is not one likely to gain immediate or general acceptance. To say nothing of the number of distinguished chemists who started in life or even passed their lives, if not as physiologists, at least as members of the medical profession, no one can fail to be struck with the fact that some of the chief epochs in the advance of physiological science have been marked by the discoveries of pure chemists. Lavoisier was a chemist; and yet the united labours of all the physiologists of the present century have hardly done as much for the science of life as was done by the immortal memoir on "The changes which air undergoes during the respiration of animals." Liebig is no physiologist, says Moleschott; and yet, with all respect to the distinguished professor at Turin, the works that bear the name of Moleschott have hardly given that impulse to the physiology of food and nutrition which, be the theories he advanced right or wrong, has been given by the researches of the former professor of Giessen. Hardly a year passes in which some chemist out of the fulness of his abundance does not throw out some truth to the hungry physiologist. A chemist or a physicist, indeed, if he be a man of reputation, has merely to float a physiological idea with his name, and it will swim buoyantly along all the meandering streams of physiological and medical literature. Nor, *pace* Moleschott, is it at all easy to mark out the line at which chemistry ends and physiology begins. If you were to take away from the scaffolding of physiology the poles of physics and the ropes of chemistry, there would probably be left hardly anything more than a few broad planks and a considerable amount of dust. If you removed from the last edition of Dr. Carpenter's 'Principles of Physiology' everything that either has been done or might have been done by men whose forces were entirely confined to chemistry or to physics, that portentously bulky volume would speedily be reduced to a portable even if not to a readable size.

At the same time it must be confessed that there has grown up, especially during the last twenty or thirty years, a department of science *sui generis*, which is by no means pure chemistry, and certainly not pure physiology—which has, to some extent, methods, aims, and cultivators of its own, and which has generally borne the name of physiological chemistry. If we might follow the example of chemical nomenclature, which has changed chloride of sodium into sodic chloride, we would say that our science would be correctly described as chemical physiology. Like sodic chloride, it is a compound in which the qualities of the constituents are mutually obscured. It is neither wholesome chemistry nor wholesome physiology; or, to change the metaphor, it is not a region of plain sailing either for the chemist or for the physiologist. The physiologist who attempts to penetrate it, often, as in several notable instances, founders upon a (to him) hidden chemical rock; the chemist, perhaps, equally often suffers shipwreck from lack of physiological ballast.

In the ordinary text-books of physiology the amount of true chemistry might be compared with Falstaff's halfpennyworth of bread were it not for the reluctance one feels in comparing the remainder of what is written to so generous a thing as sack. The special manuals of physiological chemistry, on the other hand, if they are not conspicuous for the brilliancy of their chemical views, are at least remarkable for the amount of purely chemical detail which they contain. In the well-known work of the praiseworthy Lehmann, for instance, a very large proportion of the space is taken up with matter which might readily be found in any text-book of chemistry; and the same remark applies with still greater force to the 'Animal Chemistry' of Gorup-Besanez. The writers seem to have thought that if any substance forms a natural constituent of the animal body, everything that can be said about it may fairly be introduced as physiological chemistry. Hence their books present in great part the appearance of a collection of brief chapters extracted from some chemical work. If it be said that they wrote for readers ignorant of chemistry, and that therefore they were obliged to go into chemical explanations and descriptions in the same way that some writers of chemical text-books feel called upon to include in their volumes a small treatise on physics, we may reply that at the present day such a course is both uncalled for and injurious. Before any one attempts to unravel the chemical problems of the animal body, he ought at least to have made himself acquainted with the chemical nature and proper-

ties of such bodies as oxygen, kreatin, albumin, etc. He ought to start from a fair chemical basis.

We say advisedly "chemical problems," because physiological chemistry is not an abstract science, and its true cultivators have no ambition to establish general laws. It is merely a mass of concrete problems which have to be solved, of special cases and instances which have to be explained by the help of general and special chemical knowledge. The conversion of food into flesh and blood is just a group of such concrete problems, the respiratory function is another, the oxidation of flesh and blood leading to the development of actual energy is a third. A text-book of physiological chemistry ought to take these and other groups in hand, and to treat them as particular problems, requiring a particular and concentrated application of certain parts of chemical knowledge. There ought to be neither irrelevant chemical discussions nor vain enunciations of so-called biological laws. If a problem is pronounced not only unsolved but incapable of solution through chemistry, then the matter is removed from the domain of physiological chemistry and becomes part and parcel of physiology properly so-called.

It is a great merit in Dr. Kühne's work that he does not lead his reader through a gallery of chemical pictures, arranged in alphabetical order, but at once plunges them into the chemical problems of living beings. He begins with the action of saliva, traces out the changes undergone by food in becoming part of the living body, and investigates the causes of those changes. He then goes on to consider the chemical phenomena of the tissues and fluids, and the nature of that chemical equilibrium which obtains in all living structures; and, finally, in the third part, which is not yet published, will examine the relationship existing between waste products and vital material, and the chemical arrangement by which the former are ejected in the most convenient manner from the organism.

Anything coming from Dr. Kühne is sure to embrace the very latest results and to bear the mark of an original mind; and the present work, if anything, is too original and too new, too much confidence being, perhaps, given to new views and new researches which have not as yet had the opportunity of bearing the test of time. Those who have hitherto been content with Lehmann will doubtless be somewhat aggrieved at the demolitions and reconstructions that have been going on in physiological chemistry during the last dozen years; but the book is written in a light and even piquant style, and if such persons read it at all they will read with pleasure as well as with profit.

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY

C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *April* 22.

TO-DAY is the first day that the Exhibition building has at all been filled. Being in some sort a public holiday, streams of people, mostly of the working class, have flocked into the building until it has become quite inconveniently crowded. To all intents and purposes, everything may be said at last to be in decent order. It is true that Spain, Greece, and, above all, laggard Italy, are still a good deal behindhand; but even these sluggish countries have apparently been shamed into showing a little unwonted activity in these later days. The collection of Spanish minerals seems to be very fine. They are also legibly numbered and named, the omission of which caused the mineralogical display in 1862 to be quite useless. There is a very fine collection of Prussian minerals, scientifically arranged by Dr. Wedding, of Bonn. Those who remember the splendid series arranged by this gentleman in 1862 will scarcely be surprised to hear that the present display is still more complete. The potash minerals from Stassfurt will also attract a large amount of attention, both from the manufacturer and the man of science. The discovery of bromine in the mother-liquors of the Stassfurt works is another deeply interesting fact. By the way, while on the subject of Prussian minerals, may one inquire after the fate of the collection arranged by Dr. Wedding in 1862? It was first offered, we believe, to Sir Roderick Murchison for the Geological Museum, but for some unaccountable reason it was refused by that gentleman. It was then offered to the authorities at South Kensington, who, being omnivorous, of course accepted it, and have kept it *perdu* ever since.

The mineral products of Austria are of surpassing excellence. Although few in number, as compared with the Prussian collection, they are of great interest, and show that the mineralogical resources of that great empire are almost infinite. Portugal exhibits a small but valuable collection of ores. Greece does the same—only in the catalogue, however, at present. The Italian minerals are still unarranged, having been placed in open shelves, exposed to all the dust of the building, without any labels or numbers, or, indeed, anything to indicate whence the specimens come or what they are. It need hardly be said that Sweden and Norway keep up their ancient mineralogical fame. Their collection of iron ores is particularly complete and interesting. Russia, too, exhibits well and largely. The Imperial Mint shows platinum and its ores in a series of specimens that will require a long and diligent examination. Cardinal Altieri shows a choice selection of Roman minerals from the University collection. The Turkish

collection is still in confusion; but judging from the catalogue, it ought to be good. Our own collection of minerals is disgracefully poor. Surely, if Spain, Greece, and Turkey, think it worth their while to show their mineral productions, we might do the same! The only minerals we attempt to show are coal and iron ores, and the latter are only exhibited as illustrative of the manufacture of iron. How is it that in 1862, in spite of all the pains taken by Mr. Robert Hunt and his colleagues, the collection of minerals exhibited was so wretchedly arranged and shown? Are mine-owners so jealous of each other that they will not unite together and exhibit a systematic series of British minerals? Perhaps if a clever mineralogist and indefatigable worker, like Dr. Wedding, of the Prussian department, were charged with the collection and arrangement of such a display, we might be able to take our proper place in International Exhibitions as the first mineral producing country in the world, instead of exhibiting a few isolated specimens, as we have hitherto done. Those who visited the Exhibition of 1851 must have admired the excellent collection of iron ores displayed by Mr. Blackwell, but in 1862 no one appeared to have thought it worth while to follow that gentleman's very good example. The French minerals are well displayed, but naturally they are comparatively few in number.

Continuing our examination of the collection of British chemicals, the next products that come under consideration are borax and Rochelle salt. Of these the former is exhibited by Messrs. Howards and Sons, our chief manufacturers of that salt; and the latter by Messrs. Howards and Huskissons. The Rochelle salt shown by both these firms is in large and almost perfect crystals. The former firm show the raw material from which borax is made, also some very perfect crystals of boric acid. Some years ago there was an importation made into England of the mineral known as hayesine or hydroborocalcite, which promised to replace tinkal and the Italian crude boric acid in the manufacture of this valuable salt. Borax from this material was, we believe, made in notable quantities by Messrs. Gaskell and Deacon, and exhibited by them in 1862, but as none from this source has made its appearance in the English department in 1867, we must conclude that the manufacture has ceased, or at any rate declined. Possibly the near proximity of Italy as compared with Peru —the country in which hayesine is found—may have something to do with this; but as hayesine is, we believe, simply dug out close to the surface of the earth, and as the Italian boric acid is a manufactured article, we would have thought that the advantage would have remained with the Peruvian product.

A few gross ammonia products are shown. The sulphate, muriate, and carbonate, receive representation at the hands of Messrs. Chance, of Birmingham. No one else appears to exhibit either of these compounds.

Of potassium salts there are also but few. Huskissons show some bicarbonate of potash in splendid crystals.

In aluminium compounds we have only a few specimens of alum. One in good crystals, but a great deal damaged, is from the Hurlet and Campsie Company, who also exhibit two fine masses of crystals of red and yellow prussiate of potash. The crystals of red prussiate and alum are somewhat knocked about, but such accidents as these can only result from improper packing. Two exhibitors of alum have, for some reason or other, simply deposited their crystals on rough deal stands, and have gone sulkily away, leaving them uncleaned and without labels. This kind of thing should really not be allowed by those who have charge of the class. No doubt certain exhibitors have had to suffer an immense amount of ill-treatment at the hands of M. Mazaroz, the French Commission, and the railway companies, but that is surely no reason why they should leave their products untouched and go away in a fit of sulks, like ill-tempered children who cannot get exactly what they want. One exhibitor—we will not mention names—whose products are of the most interesting description, exhibits an empty case, bearing an inscription to the effect that the articles he sent over were all damaged in transit, and that when he arrived his case was not ready, although he waited several days. The first *contretemps* might have been avoided by proper packing, as Messrs. Burbidge Burgoyne and Squires' specimen of peperine will show. The delay of which he complains need not have happened had he employed an English firm to make his case instead of a French one; or, if the delay did occur, why did he not send fresh specimens and employ a trustworthy agent to arrange them for him, instead of pasting such a confession of weakness on his empty glass case. Ill-tempered exhibitors should recollect that when they join in an exhibition they form part of a body, and are bound in honour to do as others do, and not spoil the appearance of the class by allowing their cases to remain empty.

Mr. Parkins exhibits a magnificent crystal of yellow prussiate of potash, weighing 420 pounds. The crystals of this specimen are most beautifully perfect, and are another instance of what careful packing will effect. Messrs. Foot and Co., of Battersea, exhibit a small and untidily arranged series of specimens, illustrating the manufacture of acetic acid. It is true they have an absurdly small amount of space in which to show their numerous products, but for all that they might have displayed them to much more advantage than they have done. Have they forgotten their ancient cunning of 1862, when their case was one of the best arranged in the building? Specimens of sulphate of magnesia are shown by Messrs. Howards, Huskissons, and Cork. Sulphate of alumina does not make its appearance at all. Are we to judge from this that it is no longer used? The mineral acids are represented by a single specimen of hydrochloric acid in Messrs. Huskissons' case. It is shown to illustrate a process invented by Mr. Isham Baggs and patented by Messrs. Huskissons, for obtaining the commercially pure acid of a specific gravity exceeding the highest in the market. Two measures of ordinary yellow hydrochloric acid are mixed in a suitable retort with one measure of strong oil of vitriol. Sufficient heat is generated by the mixture to cause hydrochloric acid of a specific

gravity of 1·210 to pass over almost perfectly free from iron and arsenic. The advantage of obtaining an acid of high specific gravity may not be very great, but a process for obtaining the pure acid at once so easily and quickly cannot fail to be of the greatest commercial value. Not a single specimen of commercial bichromate of potash is exhibited.

It will be seen from what has been written above that the display of gross chemicals, upon the production of which the chemical manufacturing greatness of England depends, is exceedingly meagre. The manufacturers of Lancashire and the Tyne have not performed their duty in remaining behind as they have done. All the more honour and credit to those who have come forward. Possibly the defaulters have not been sufficiently worried and bullied by those who have had the getting up of this department. The British manufacturer is an exceedingly coy and difficult being to deal with, and it requires a fine judgment to know whether to coax or to bully him. In exhibitions like the present there will be always a number of baking-powder and soda-water makers who are only too glad to exhibit, as a good and cheap advertisement, the difficulty being to bring in such firms as Rumney and Co., Roberts Dale, and Co., Peter Spence, Simpson Maule and Nicholson, Perkin and Sons, and a host of others who are conspicuous by their absence on the present occasion. Such men as these have, of course, nothing to gain by exhibiting their products, but they should endeavour to be more public-spirited, and become exhibitors, not merely for their individual gain, but to show that England is the greatest chemical manufacturing nation in the world.

CORRESPONDENCE.

PARIS EXHIBITION—CHEMICAL DEPARTMENT.

To the Editor of THE LABORATORY.

SIR,—It appears to me that your Paris correspondent hardly lays the blame in the right quarter in his strictures on Messrs. Mazaroz. These gentlemen were delayed in the first instance by the incorrectness of the plans furnished to the English by the Imperial Commission, subsequently by the state of the roof, and finally by the impossibility of getting the French workmen to make any effort towards completing the work by the appointed time. Of "culpable shortcomings" I must entirely exonerate them, nor can they be justly held responsible for the insolent behaviour of the workmen.

I can speak from experience of the peculiar temper displayed by most of the skilled workmen during the week previous to the opening of the Exhibition, rendering it a difficult matter to persuade them to work at all; and they were so harassed by individual exhibitors wanting them to perform the impossible feat of being in two or three places at once, that they more than once left the work altogether.

Had Class 44 been *more behindhand* than the rest of the Exhibition I should have been less surprised by the severity of your correspondent's strictures, but such was not the case. Although many cases were incomplete on the day of the opening, very complimentary remarks were made by visitors as to the forwardness of the class, and the goods of every exhibitor were ready for the inspection of the Jury (with the exception of one case, from which the goods were removed after being arranged).

The position held by Messrs. Mazaroz, as the largest contractors in the French section, and the designers of the decorations of the Central Hall, has caused them to be viewed with great jealousy by the English contractors and officials, and many rumours have been circulated to their disadvantage, but I can assert, from the personal intercourse I had with the head of the house, that no one was more vexed than himself at the inconvenience to which some exhibitors were put by their prolonged stay in Paris, but which, from a combination of circumstances, he was for a moment powerless to prevent.

I trust that my testimony will be considered disinterested, as I am not only an exhibitor myself, but am also the representative of the exhibitors in their dealings with Messrs. Mazaroz.

I am, sir, yours obediently,

S. L. HOWARD,
Chairman of the Trade Committee of Class 44.

April 18, 1867.

CLAUS ON SUCCINIC ACID.

To the Editor of THE LABORATORY.

SIR,—In the excellent digests of foreign memoirs furnished to your Journal by Messrs. Watts and Mills there occurred, last week, a reference to a paper of mine on the "Metamorphoses of Oxalic Acid." The researches of M. Claus have shown certain results contradictory, according to this chemist, of my earlier experiments. Would you permit me to deny the assertions put into my mouth by M. Claus? I will do so very briefly. (1) I did not assert that oxalic acid yields by reduction "a substance isomeric with acetic acid." (2) I never stated that "succinic acid might be made to yield butylactic acid." All my experiments were merely preliminary, and, as the following extracts from my paper* show, were not deemed by myself to be adequate proof of my anticipations:

"If the preliminary examination of these substances has conducted me to a correct conclusion, and I am right in supposing the last-mentioned acid to have the formula assigned to it, we have a new isomer of acetic acid. . . .

It will not be unreasonable to expect corresponding results from the action of nascent hydrogen on the homologues and analogues of oxalic acid, and the acid and neutral ethers of these acids.

I have commenced a few experiments in this direction also. . . But the products of these reactions, obtained only within the last few hours, await further purification and analysis; and it would be altogether premature to express any opinion as to their composition."

I am, sir, yours faithfully,

A. H. CHURCH.

Royal Agricultural College, Cirencester, April 23, 1867.

* 'Journal Chem. Soc.,' 1864 [2], p. 301.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *April* 22, 1867.

Meeting of the Académie of the 15th April—Prof. Deville's Lecture on Affinity—Dinner given by the chemists and physicists of France to their foreign visitors.

I THUS condense the papers of chemical interest brought before the Académie of the 15th of April.

MM. Wurtz and Kekulé have found a competitor in M. Dusart, who begs the Académie to order the secretary to open a sealed note deposited on the 20th of March, 1864. Sealed notes are sometimes presented in order to secure the honour of priority when some reason or other prevents the author from giving publicity to a discovery. The reason in this instance was the desire of obtaining pecuniary advantage from the processes described in the sealed note. When opened, M. Dusart's note was found to refer to the preparation of phenols, the process described being the same as that given by Wurtz and Kekulé at the last meeting. Corresponding compounds have been obtained by M. Dusart with oil of turpentine and with naphthaline. He does not describe these compounds, but he ascribes to the former a formula identical with that of camphor (?). It is said to form a beautifully crystallised salt with potash. All these compounds share the property of absording oxygen when heated with lime and potash in the presence of air, and of thus forming red or yellow colouring matter, playing the part of feeble acids.

M. Dufresne reverts to his gilding process, which, he asserts, differs from that of M. Cristofle, and does not expose the workman to the influence of mercury vapour.

M. Fizeau publishes new observations on iodide of silver, establishing the fact that the amorphous as well as the crystallised salt *contracts* when heated. It has been produced in the amorphous state by compressing precipitated iodide. When thus prepared, it is perfectly homogeneous, but does not act on polarised light.

Father Secchi communicates the result of spectroscopic observations of more than 400 stars made by him at the observatory of Rome. He also communicates a note on the transparency of iron when heated to redness. The tube which served for this observation consisted of forged sheet-iron of half a centimètre in thickness.

M. Longuinine, in a note on the action of chloride of zinc on aromatic aldehydes, reports that this reagent does not act on oil of bitter almonds, whereas cuminic aldehyde, $C_{10}H_{12}O$, is split up into H_2O and a hydrocarbon. But the latter, instead of being $C_{10}H_{10}$, proves to be $C_{10}H_{14}$, cymene, produced most likely by the destruction of part of the aldehyde, with the consequent production of nascent hydrogen. The difference in the behaviour of the two aldehydes is founded on the different position of the hydrogen necessary to form water, benzoic aldehyde resisting the action of chloride of zinc, because one atom of hydrogen would have to be taken from the principal chain. M. Longuinine applies to these compounds the rational formula of Kekulé, thus:

$$\underset{\text{Benzoic aldehyde.}}{C_6H_5 - COH} \quad \text{and} \quad \underset{\text{Cuminic aldehyde.}}{C_6H_4\begin{cases} COH \\ C_3H_7 \end{cases}}$$

M. Berthelot publishes a second continuation of his paper on a universal method of reducing organic compounds, which will be reported upon in a future communication.

Dismissing the Académie, I will now turn to a subject which has been occupying for some time the attention of scientific Paris. I am speaking of the lectures on Affinity and Cohesion, and on the Mechanical phenomena of Combination delivered before the members of our Chemical Society by Professor Deville. They show us united in one mind the two contrasting characteristics of French science to which I alluded in one of my letters, viz. love of progress and conservative fear of hypotheses and theories.

A striking comparison proposed by an English critic—Carlyle, if I mistake not—to distinguish the two chief classes of novelists is equally applicable to scientific writers. Some, like spiders, draw the thread of their work out of their own selves. These are the theorists in the realm of science. Others, like busy ants, carry together heaps of useful material. These are the men who love facts and experiments for their own sake, quite independently of any conclusions that might be drawn from them. Henry St. Claire Deville is the truest representative of this class of philosophers; a most attentive and unremitting observer; a most skilful experimentalist, full of inventive power in combining new methods and apparatus, and full of distrust for all hypotheses and theories. Still, he is unable to do without hypotheses of his own, in order to group and animate his observations. He is, therefore, found attacking more or less violently theories and hypotheses in general, and defending now and then some particular conclusion more extraordinary than those which he attacks. To him exceptions not only veil, but annihilate the rule. He denies the existence of the law of vapour densities. But he admits that gases dissolving in water, and therefore disengaging heat, will at last be decomposed by the heat they produce, so that carbonic acid in the juice of plants no longer exists as carbonic acid, but as carbon and as oxygen!*

While lecturing before the members of the Société Chimique, he tacitly defends the usefulness of theories while he attacks them; for he never chooses stubborn facts as the subject of his lectures, but the theories themselves which he denies, thus clearly proving that facts have no claim upon our interest unless combined by links, that is, by theories.

This time he attacks the theory of Affinity, warmly, earnestly, as if we were living in the time of Bergman; as if affinity were more than a name to-day; as if everybody who pronounces it were not conscious of his ignorance as to the real cause of combination; and far from believing affinity to be an elementary force, like electricity or gravitation.

* 'Leçons de Chimie professées en 1864 et 1865,' page 274, Paris, Hachette, 1866.

The professor commences his discourse by paying an eloquent and touching compliment to the memory of Verdet the learned physicist, who died young some months ago, and who, not long before his death, from the same place where Deville now stood, explained the principles of the mechanical theory of heat.

Combination and dissolution, Deville continues, are nothing but changes in the condition of matter, characterised by the production of certain physical properties, which do not exist or which exist to a smaller degree only in the mixture of uncombined matter. Changes of condition with regard to cohesion and changes of condition with regard to combination are therefore accompanied by the same or nearly the same physical circumstances, their general character being loss or gain of latent heat. The disappearing heat has, of course, been employed to perform some molecular labour, which, when disappearing in its turn, will reappear in the shape of perceptible heat. Thus, when hydrogen and chlorine suffer a change of condition by combining to form hydrochloric acid, they loose 652 units of heat pre-existing in these elements as latent heat. Now, it is generally supposed that the cause of combination and of the disengagement of heat during combination is a force unknown and occult, yet, for all that, it is the key that opens the mysteries of our chemical operations.

Affinity is considered to be great or small or elective. It appears to be endowed with some sort of reason, having preferences and sentiments, being satisfied or not satisfied, and being considered sometimes to increase, sometimes to decrease, with an elevation of temperature. This force, undefined and never measured, is considered to consist of so many unities. How many kilogrammes in weight does each unity of affinity represent?

The lecturer here evidently refers to the expressions monaffine, diaffine, etc., lately applied to certain elements and compounds, expressions to which he has a right to object, and for which the better terms of univalent, bivalent, etc., or of monatomic, diatomic, or of monad, dyad, etc., have been substituted by Hofmann, Wurtz, Kekulé, and Frankland respectively. But whoever thought of measuring affinity when applying the above expressions? The lecturer, who so strongly condemns the word affinity, permits the use of the expression *latent heat*, although he admits our perfect ignorance as to the transformation of heat when it is said to become latent.

He then proceeds:—As affinity disappears by combination, producing heat or some equivalent labour, without endowing the compound formed with some new molecular energies, we can dispense with the word affinity altogether, and speak of the effect produced instead of the unknown cause.

If you heat hydrochloric acid so as to give back to the compound the 652 units of heat that hydrogen and chlorine lost on combination, you will reproduce the uncombined elements with their original properties and with their affinities into the bargain. The idea was expressed long ago by Lavoisier and Laplace when they pronounced that—"All real and all apparent variations of temperature which a system of bodies exhibits while changing its condition are reproduced in the opposite sense when the system returns to its primitive state." With the addition of the term, "whenever this change of condition is unaccompanied by external labour," this sentence would contain the mechanical theory of heat. As the effects of affinity can be expressed in heat-units, the professor considers affinity to be an unnecessary expression; he considers it as false as the expression of "vital force," which is gradually disappearing from physiological writings.

The word affinity has been losing ground in chemical publications, from the time that Berthollet tried to banish it sixty years ago. He destroyed Geoffroy's tables of affinity, explaining by cohesion the formation of insoluble and of volatile combinations. But cohesion to Professor Deville is equally objectionable an expression as affinity, signifying, as it does, an occult cause.

Conversing on the subject with M. Dumas, the lecturer elicited, some years ago, the following remarkable explanation of the laws of Berthollet. Sulphate of potassium, as M. Dumas observed, exhibits a much smaller contraction than sulphate of calcium, which itself shows an inferior contraction to that of sulphate of barium. Should it not be a general rule, M. Deville asks, that those salts are formed, when mixing different solutions, which exhibit the greatest contraction and consequently the greatest insolubility; and, again, those which exhibit the smallest contraction, and consequently the greatest volatility? Contraction is always attended with evolution of heat, which may be considered as a function of the density of the combining elements, and of the density, dilatation, and specific heat of the compound. Experiments on this subject the lecturer promised soon to publish.

I cannot refrain from introducing here a remark of M. Berthelot published at the meeting of the Académie of the 4th of March. This remark is to the effect that those reactions generally take place which produce an appreciable quantity of heat, so that, under ordinary circumstances, it may be predicted whether a reaction will take place in one way or in the opposite way by calculating the heat disengaged in both instances. For instance, to decide whether iodide of silver will be decomposed by hydrochloric acid, or whether chloride of silver will be decomposed by hydriodic acid, the following data will suffice:

$Ag + I = AgI$	disengage	18,600 heat-units.
$H + Cl = HCl$ (in solution)		40,200 „
		58,800
$Ag + Cl = AgCl$	disengage	34,800 „
$H + I = HI$	„	15,000 „
		49,800

58,800 — 49,800 = 9000 heat-units will, therefore, be disengaged when chloride of silver is treated by hydriodic acid. The reaction $AgCl + HI = AgI + HCl$ may therefore be predicted, such as really takes place according to the discovery of the very

professor whose lecture we have thus interrupted to introduce a subject so closely connected with it.

In continuing, Professor Deville exhorts his audience, and "in particular those young and arduous workers whose numerous researches contribute much to spread the fame of Professor Wurtz's school of chemistry," to study attentively the physical properties of new bodies, and thus to assist in the efforts to discover the mechanical law of the transformation of matter, or to reduce the questions of chemistry to questions of thermodynamics.

With this exhortation the lecturer virtually ended his discourse, leaving those few who until then believed in affinity as a distinct force cured of their error, and leaving the rest of the audience wondering why it should be wrong to designate the complicated causes of combination by a simple word affinity, when it is permissible to designate the occult cause of attraction by the simple word gravitation; the connection between heat and combination being not more intimate than that between heat and attraction. I say this lecture thus ended virtually, because, in point of fact, a very interesting appendix was attached to it, explaining the lecturer's views on cohesion.

Whenever—so he somewhat abruptly continued—a solid body is produced from solutions or otherwise, so that its molecules cannot take the particular directions or form the particular unions which determine crystallisation, the solid is precipitated in the form of a powder. A perfect powder, such as precipitated sulphate of barium, constitutes, therefore, a loose aggregate of single molecules, or rather of particles, the dimensions of which are comparable to those of its molecules (poudre tellement ténue, que chacune de ses particules peut avoir des dimensions comparables à celles de sa molécule). Copper and silver precipitated by an electrical current are in the same condition, being, as it were, not solids, but powders—powders, liquids, and gases, constituting the three states which a body may take when first produced. To convert a powder into a solid, it must be fused, dissolved and allowed to solidify, or it must be pressed together (like platinum-black). These actions have the effect of felting the loose molecules together, in certain directions which depend upon their particular nature. Now, in taking these directions the particles most likely spend a certain quantity of heat, converting the same into internal labour, which becomes appreciable as contraction. External heat overcomes this contraction, and by giving back to the matter all the heat spent in contraction, as well as in directing its molecules, we destroy its cohesion, thus converting it into a liquid. M. Person has found, indeed, that the mechanical labour necessary to destroy the continuity of solids is nearly equivalent to the heat required for melting the same. Heat, therefore, plays the same part with regard to cohesion as it does with regard to affinity. It plays the part of the force which a weaver spends in uniting his threads, and which is finally represented by the tenacity of the woven fabric. Gases differ from liquids in the nature and energy of the motions that animate their molecules, and a similar difference exists between solids and liquids. To cohesion, as well as to affinity, therefore, the lecturer applied the following words spoken by the late M. Verdet with regard to friction:

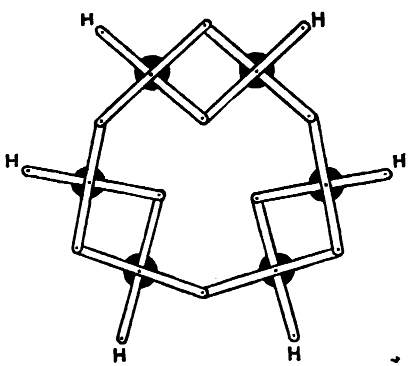
"We cannot consider it as anything but a pure mathematical fiction—useful, perhaps, as a provisional representation of an unknown mechanism, but quite inadmissible as the expression of reality."

I am obliged to leave for a future letter an analysis of Prof. Deville's second lecture, "On some Mechanical Phenomena of Combination."

A dinner will be given this evening by the Chemists and Physicists of France to the Members of the Jury of Class 44, and to other men of science attracted to Paris by the Exhibition. M. Dumas will be in the chair. M. Fremy, Baron Thénard, and M. Wurtz being the other members of the committee. [See notice, p. 58.]

ROYAL SOCIETY OF EDINBURGH.

In my last report I referred to Mr. Dewar's "*Mechanical Contrivance for Illustrating Structure in Non-saturated Hydrocarbons*," and I now give a description of the little instrument. Every carbon atom is represented by a circular disc, to the centre of which two thin slips of brass are attached crosswise by means of a pin, so that they can freely move in a plane and be set to form any angle with each other. The four ends of the slips represent units of affinity, and in the case of two affinities saturating each other the respective ends of the slips are screwed together. The accompanying figure, illustrating one of the many different views as to the constitution of benzol, will show clearly how the instrument is intended to be used.



At one of the meetings of this session Professor Playfair made a communication respecting "*The Constitution of Nitroprussides.*" The professor does not accept Mr. Hadow's views, according to which these salts are formed the substitution, in ferricyanides, of N_2O_3 for 2CyH, but still adheres to his original formulæ, in which NO figures as replacing HCy. He finds, by a number of carefully conducted

experiments, that when a solution of ferricyanide of potassium, mixed with a sufficiency of acid to liberate one atom of CyH, is treated with nitric oxide under conditions which preclude the possibility of an oxidation of the latter previous to its action on the ferricyanide, nitroprusside is formed and HCy liberated. The reaction, however, proceeds so very slowly that it could not be made available for the preparation of nitroprussides in quantity. For this purpose the professor recommends the following process as giving excellent results:—Equal quantities of ferricyanide of potassium and of tartaric acid are separately dissolved in the smallest quantities of water. One half of the tartaric acid is added to the ferricyanide, the mixture stirred, and the supernatant liquid decanted from the precipitate of bitartrate of potassium; half an equivalent of nitrite of sodium ($\frac{1}{2}NO_2Na$) is now added (in the form of a concentrated solution of known strength), and also one equivalent of chloride of sodium (NaCl), whereupon a new quantity of cream of tartar is precipitated, from which the liquid is at once separated by decantation. The clear liquid is now as quickly as possible heated to ebullition, and to the boiling fluid another half equivalent of nitrite of sodium is gradually added, to make up for what has disappeared in the reaction. The nitrite must never be allowed to predominate, because it would reduce some of the ferricyanide to the ferrocyanide—the red to the yellow prussiate. The mixture must, from time to time, be tested for ferricyanide (by means of ferrous sulphate), when this salt will be found gradually to disappear; the last traces, however, it is difficult to obliterate. After one or two hours' boiling the process is completed, and the liquid will, on evaporation, yield two crops of nearly pure nitroprusside of sodium. The reaction going on in the process is represented by the equation—

$$2FeCy_6K_2H + 2NO_2H = 2H_2O + 2Cy + 2FeCy_5(NO)K_2.$$

The nitroprusside of potassium readily exchanges its potassium for the sodium of the tartrate and chloride of sodium present in the mixture.

At another meeting your correspondent read a paper "*On the Analysis of Compound Ethers.*" He drew attention to the fact that the titration of ethers by means of standard alkali was first introduced, many years ago, by F. Mohr, who employed it for testing the officinal "æther aceticus." The method was afterwards further developed and extensively employed by Berthelot. Berthelot's process consisted in heating the ether in a sealed-up glass tube with standard baryta, and determining by titration, the amount of baryta left unsaturated. When your correspondent, some time ago, attempted to use Berthelot's method for testing what he had reason to look upon as very pure formiate of ethyl, he was surprised by obtaining inexplicable results. A critical examination of the method showed that the discrepancies were caused by the action of the caustic baryta on the glass. A standard solution of carbonate of sodium was now tried, but was also found to be considerably altered in strength when heated in a sealed-up glass tube to 110° C. for twenty-four hours. At last, it was found that of all the practically available alkaline solutions, caustic ammonia was the only one which gave accurate results when heated in sealed glass tubes. In order to see if ammonia could be employed in the titration of compound ethers, a series of experiments was instituted in which weighed quantities of glacial acetic acid were first partially etherified by heating them with excess of strong alcohol (of 95 per cent.) to 140° C. for some hours, and then acted upon with an excess of standard ammonia at 100° C. for twenty-four hours. The resulting liquids were titrated with standard hydrochloric acid and ammonia (always finishing with the latter), and the amounts of ammonia saturated by the acetic acid compared with those which, according to direct experiment, would have been required in titrating the acid directly with ammonia. The results obtained were, in some cases, surprisingly exact, in others there were errors amounting to 2 per cent. and more. Although the errors of the method, and the means of eliminating them, could, no doubt, be found out by a series of critical experiments, the author preferred to return to the application of standard baryta, substituting, however, for the sealed-up glass tube a copper digester provided with a conical stopper which could be securely fastened by means of a screw. The digester was made of strong sheet copper, and the seam soldered with sterling silver. When such an apparatus was charged with water, weighed, then kept at 120° C. for three or four hours and weighed again, there was no loss observable with a balance which would have indicated 2 centigrammes. After the apparatus had been thus tested, a number of experiments were made on partially etherified acetic acid in a manner exactly analogous to the one adopted in the case of the tritrations with ammonia. The resulting liquid was found to be, practically, free from copper, and the quantities of acetic acid calculated from the tritration with baryta were found to be correct within about $\frac{1}{10}$ of the whole amount. A higher degree of accuracy could probably be attained by determining the excess of baryta, not by direct titration, but by first precipitating it with carbonic acid, and then titrating the carbonate. The indistinctness in the point of saturation, observed in the titration of weak acids, would thus be entirely eliminated. This modification of the process would offer an additional advantage. The filtrate from the carbonate of barium might be evaporated to dryness, and the salt obtained be tested by determining its percentage of barium.

The author's experiments were nearly completed when Mr. Wanklyn's paper "*On the Titration of Ethers*" was published. Mr. Wanklyn effects the decomposition of the ether by heating it, for *a few hours*, with alcoholic potash in an open flask, and the results he gives are very satisfactory. Unfortunately, Mr. Wanklyn's method is only applicable in a limited number of cases.

WILLIAM DITTMAR.

Chemical Laboratory, University o Edinburgh.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S., AND E. J. MILLS, D.SC.

On the Coefficient of Expansion and the Density of the Vapour of Nitric Peroxide. By H. SAINTE-CLAIRE DEVILLE *and* L. TROOST.*

THE vapour of nitric peroxide at temperatures considerable above its boiling-point exhibits a degree of condensation agreeing with the formula NO_2 $\left(\frac{14 + 2 \cdot 16}{2} \times 0{\cdot}0693 = 1{\cdot}589\right)$. If, however, the formula be doubled, in accordance with the notions of atomic constitution now generally entertained, the vapour will exhibit the anomalous condensation to four volumes. MM. Playfair and Wanklyn have, indeed, determined the vapour-density of this compound at different temperatures below its boiling-point, by diffusing the vapour through a permanent gas which has no action upon it, namely, nitrogen, and have obtained values intermediate between 1·589, the vapour-density corresponding to the formula NO_2 and 3·168, which corresponds to N_2O_4 (viz. 1·783 at 97·5°, 2·520 at 24·5°, 2·645 at 11·3°, and 2·588 at 4·2°). Hence they infer that nitric peroxide probably exists in two modifications, NO_2 and N_2O_4, which pass readily one into the other, the vapour at temperatures near 100° consisting chiefly of NO_2, at ordinary temperatures of N_2O_4, and at intermediate temperatures of mixtures of the two in various proportions. Their calculations, however, involve the assumption that the expansion-coefficient of the vapour is at all temperatures the same as that of a permanent gas, viz., 0·00367, a point which cannot be safely assumed without experimental verification.

MM. Deville and Troost have accordingly endeavoured to determine the expansion-coefficient of nitric peroxide vapour at various temperatures by the following method. A glass globe having a capacity of 800 to 900 cubic centimètres was filled with the vapour of nitric peroxide, then placed in a water-bath having a temperature very little above that at which the compound boils; the neck was sealed as soon as the vapour had ceased to escape from it, and the globe weighed in the usual way. The water-bath was next heated to a temperature from 5 to 10 degrees higher than before; the globe, with its neck still sealed, immersed in it for half an hour; a small portion of the neck then broken off and preserved for weighing; the tube again sealed after the vapour had ceased to expand; and a second weighing made. The same series of operations was then gone through at the temperature of 100°, and subsequently at still higher temperatures.

If, now, V be the capacity of the globe (= 846·8 c.c.), P the weight of the vapour contained in it at the temperature t, k the expansion-coefficient of glass, β that of nitric peroxide vapour between two consecutive values of t; then the volume occupied by 1 grm. of vapour at t degrees will be $\frac{V(1 + kt)}{P}$.

* 'Comptes rendus,' lxiv, 237 (11 Février, 1867).

The following table contains the results of the experiments:

t	D*	P	$\frac{V(1+kt)}{P}$	$100\,\beta$
26·7°	2·65	2·604	320·36	0·888
35·4	2·53	2·419	345·12	1·008
39·8	2·46	2·358	360·42	1·215
49·6	2·27	2·108	403·33	1·207
60·2	2·08	1·870	454·95	1·137
70·0	1·92	1·668	505·85	0·946
80·6	1·80	1·530	556·37	0·781
90·0	1·72	1·426	597·22	0·531
100·1	1·68	1·354	629·33	0·441
111·3	1·65	1·291	660·29	0·422
121·5	1·62	1·240	688·74	0·378
135·0	1·60	1·180	723·87	0·367
154·0	1·58	1·118	764·40	
183·2	1·57	1·037	824·77	

The numbers in the last column of this table exhibit a very remarkable phenomenon, namely, a *maximum value* of β corresponding to the temperature of 40°. This the authors believe to be the first observation of such a maximum; it might, perhaps, be detected in the case of other bodies, by calculating, as above, the volume occupied by 1 gramme of the vapour at different temperatures, and thence determining the expansion-coefficient between those temperatures. The result may be worked out by a very simple formula, expressed as a function of the vapour-density.

Let D be the density calculated for the variable temperature t, and a the expansion-coefficient of air; then, for the volume v occupied by 1 gramme of substance, we have—

$$v = \frac{1 + a\,t}{1{\cdot}293\,D};$$

and calling Δv the difference of the values of v between two corresponding values of D and t, and Δt the difference of the two temperatures, the coefficient of expansion between these limits will be—

$$\frac{\Delta v}{\Delta t} = \beta.$$

The table shows, in the second place, that at about the temperature of 137° the expansion-coefficient of nitric peroxide is the same as that of a perfect gas, viz. 0·00367, and that from this temperature upwards the density of the vapour does not vary sensibly through an interval of 47 degrees.

* D is the density calculated on the hypothesis that nitric peroxide is a perfect gas, obeying Mariotte's law, and having $\beta = a$ = 0·00367.

Moreover, from 100° to 183° the vapour-density varies only from 1·68 to 1·57, that is to say, by 0·11, a difference which may be neglected if we take into account the various causes of error accompanying such determinations. On the other hand, between 26·7° and 100°, that is to say, in an interval of only 73°, the density varies from 2·65 to 1·68, that is, by about a unit, a difference which is nine times as great as that between 100° and 183°, and does not admit of any conclusion being drawn as to the constitution of the vapour.

In fact, for all vapours condensable above zero, the so-called vapour-density is a pure mathematical fiction, to which it is impossible to assign any physical meaning. Its interpretation becomes possible only when the density is taken at a temperature so far above the boiling-point of the liquid that the vapour obeys Mariotte's law, and has the expansion-coefficient 0·00367 belonging to perfect gases. It that case the density, reduced to 0° C. and 760 mm., is exactly that which the vapour would have at this pressure and temperature if it could be reduced thereto without liquefaction.

The vapour-density of nitric peroxide is, therefore, universally and necessarily equal to 1·589, representing two volumes of vapour for the molecule NO_2; and if, as suggested by R. Müller,* the formula be doubled, so as to represent the molecule by N_2O_4, this molecule will correspond to four volumes of vapour, thereby adding one more to the already somewhat numerous category of anomalous vapour-densities.

Wurtz, in his 'Chimie Moderne' (p. 156), suggests that the anomaly of the vapour-density of nitric peroxide may be due to dissociation (that is, probably to the resolution of the compound into nitric oxide and oxygen). If so, pernitric oxide must have but a very ephemeral existence; for, according to calculations founded on the observations of Playfair and Wanklyn, the vapour, even at —11°, at which point it solidifies, would not attain the density of 3·168, which the molecule N_2O_4 should exhibit if still undecomposed. We should therefore be led to the improbable conclusion that one of the most stable compounds of oxygen and nitrogen begins to decompose at a temperature far below zero.

On the Polymers of Valerylene. By E. Reboul.†

When strong sulphuric acid is agitated with valerylene, an energetic action takes place, and great heat is evolved, rendering it necessary to cool the liquid after each addition of the hydrocarbon. The first portions appear to dissolve; but soon there separates a dark violet oily layer, which floats on the surface. On agitating with water, decanting the oily layer, and washing it with solution of potassic carbonate, the colour disappears almost entirely, and a somewhat viscid yellow oil remains. The dilute sulphuric acid separated from this oil yields but an insignificant quantity of a very hygroscopic barium-salt when saturated with carbonate of barium and evaporated.

* 'Ann. Ch. Pharm.,' cxxiii, 1.

† Comptes rendus,' lxiv, 419 (4 Mars, 1867).

The yellow oil yields by fractional distillation—

1. *Hydrate of Divalerylene*, $(C_5H_8)_2.H_2O$, in the form of a very mobile liquid, lighter than water, and insoluble therein, boiling at 175°—177°, having a strong but pleasant odour, recalling that of mint and also that of turpentine oil. This compound is exactly analogous to hydrate of diamylene, and is probably the ether of monohydrate of valerylene, or valerylenic pseudo-alcohol described in a preceding communication.*

2. *Trivalerylene*, $C_{15}H_{24}$.—This compound, which distils between 265° and 275°, is a yellowish oily liquid, insoluble in water, and having a sp. gr. of 0·862 at 15°. It smells like oil of turpentine, with which it is isomeric.

This is not the only polymer resulting from the action of sulphuric acid on valerylene. On continuing to distil the liquid which has not passed over at 275°—280°, the boiling-point rises continually, and a liquid passes over of more and more oily consistence. If the distillation be stopped at 350°, there remains a somewhat copious residue, which concretes on cooling to a nearly solid, semi-transparent, brownish-yellow mass, which is a mixture of several more highly condensed valerylenes

Sulphuric acid diluted with a third, a half, or a nearly equal volume of water, acts like the concentrated acid, but less violently and with less coloration. As the acid is more and more diluted, the product contains a larger proportion of the compounds $2C_5H_8.H_2O$ and $C_{15}H_{24}$, and less of the higher polymers. But whatever may be the proportion of acid and water, there is no divalerylene or hydrate of valerylene formed.

Chloride of zinc, heated with valerylene to 160°—180°, produces the same polymers as sulphuric acid.

Errata.—*Page* 18, Table IV, sixth column: for 1·0000000, 1·0005711, etc., *read* 0·0000000, 0·0005711, etc., substituting 0· for 1. throughout the column.

Page 23, second col., 2 lines from bottom: for "where the mercury and oxygen are liberated as half molecules, or atoms," *read* "where oxygen is liberated as a half molecule or atom."

Page 49, second col.: for + H_2O in the equation, *read* — H_2O.

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42a, Cannon Street, E.C.

MEETINGS FOR THE FORTHCOMING WEEK.

April.		
Monday,	29.	Medical Society. 8 p.m.
„		Philosophical Club. 6 p.m. Anniversary.
Tuesday,	30.	Royal Institution. 3 p.m. Prof. Blackie, *On Plato.*
„		Civil Engineers. 8 p.m.
May.		
Wednesday,	1.	Royal Institution. 2 p.m. Annual Meeting.
„		Society of Arts. 8 p.m.
Thursday,	2.	Royal Institution. 3 p.m. Prof. Huxley, *On Ethnology.*
„		Royal Society. 8.30 p.m.
„		Royal Society Club. 6 p.m.
„		Chemical Society. 8 p.m.
Friday,	3.	Royal Institution. 8 p.m. Prof. Blackie, *On the Music of Speech in Greek and Latin.*
Saturday,	4.	Royal Institution. 3 p.m. Prof. Huxley, *On Ethnology.*

* See page 30 of this volume.

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CONTENTS.

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CHEMICAL SOCIETY.

THURSDAY, APRIL 18.*

J. H. Gladstone, Esq., Ph.D., F.R.S., Vice-President, in the Chair.

The minutes of the previous meeting were read and confirmed, and several donations to the Library announced.

Certificates of candidates for election read for the first time were those of Walter William Fiddes, Sothernhaye, Clifton; Robert R. Tattock, Ryles of Bute, by Greenock, N.B.

For the second time were read the names of William Gowland, Sheffield; George Robert Gowland, Sheffield; John Cargill Brough, Stockwell; Edward Packard, Ipswich; F. W. Petterson (of Her Majesty's Mint, Calcutta).

Mr. William Phipson Beale, Lincoln's Inn, was duly elected a Fellow of the Society.

Mr. Alfred Coleman, was balloted for, but, as the votes in his favour did not reach the proportion of three fourths, according to By-Law I, he was not elected a Fellow.

Mr. J. Spiller read a paper "*On the Weathering of Copper Ores.*" It is well known that the sulphur ores of copper are oxidised by exposure to the air, with a degree of rapidity depending upon the amount of moisture, the temperature, and the purity of the mineral, iron pyrites greatly promoting the action. The author had found crystals of sulphate of copper amongst the ore deposited on the platforms of copper mines, of which crystals he showed a specimen. In conjunction with Mr. A. H. Church, he had investigated the changes of the Devonshire cupriferous pyrites. Two analyses of this ore gave—

Cupriferous pyrites	36	40
Spathic iron ore	10	14
Schist, sand, etc.	54	46
	100	100
Percentage of metallic copper.....................	8	9

The "tailings" from these ores contained a considerable quantity of cupriferous pyrites, corresponding in one sample to as much as 2·9 per cent. of copper. On examining the water of the stream used for washing the ore above the mine, he found it contained no sulphates, and but a small quantity of carbonate of calcium. Below the mine it contained sulphates of iron, copper, calcium, aluminium, and manganese, but no carbonates. Particles of cupriferous pyrites were held in suspension in the stream. He had made experiments both on the cupriferous pyrites from the mine and also on the "tailings," and found that 1 lb. of pulverised ore, which contained no soluble constituents after exposure for twelve months, gave 50 grs. of soluble matter, consisting of sulphates of copper, iron, manganese, aluminium, and calcium. An equal weight of the "tailings," under similar circumstances, gave 64 grs. The results of these experiments verified the statements previously made of the conversion of sulphides into sulphates. The author concluded by saying that vast quantities of copper were wasted in the ordinary mining operations, which it was very desirable to utilise, especially as great damage was done to vegetation by metallic impurities dissolved and held in suspension by the stream.

Dr. Gladstone thanked the author for his paper, and said that he observed many metallurgical chemists present, who, he had no doubt, could give some interesting observations.

Mr. D. Forbes observed that the quantity of copper in one of the samples of tailings, 2·9 per cent., was very high, and that the mine must be very badly worked, as these "tailings" could be concentrated at about one fifth the cost of raising the ore from the mine. In the south of Spain the copper ore, just as it came from the mine, was exposed to the air on an inclined plane and frequently watered, the solution of cupric sulphate being precipitated by metallic iron. He had also observed that, when cupriferous pyrites was slowly oxidised in mines in a limited supply of air, crystals of metallic copper were formed. These were hexagonal, and therefore pseudomorphs, and on breaking them open the nucleus was found to be arragonite.

Mr. F. Field said that in a horizontal chimney of a copper-smelting furnace in Chili, situated on the sea-shore, he had found large quantities of cupric sulphate and oxychloride of copper, the production of the latter being explained by the contiguity of the sea.

Prof. A. H. Church said that what was particularly interesting to him was the injurious effect of the metallic impurities of the water from copper mines upon vegetation. The streams were employed to irrigate the meadows, and the farmers found that since the mines had been worked the produce of hay had been reduced one half. Above the mines the streams were full of water weeds, and below they were entirely destroyed. On the bed of the stream was formed a deposit which at two miles from the mines contained 20·7 grs. of metallic copper in the pound. On evaporating some of the water to dryness he had observed a blue coloration which he had traced to the presence of a salt of cobalt.

Mr. E. T. Chapman then read a paper "*On the Oxidation of the Acids of the Lactic Series,*" detailing researches which he had made in conjunction with Mr. M. H. Smith. In former papers on oxidation he had directed his attention to methods rather than to the products obtained. On oxidising acids of the lactic series he found that aldehydes or ketones were produced, according as the acid was a primary or secondary lactic acid—that is, contained one or two alcohol radicles, the general formula being—

$$\left.C\left\{\begin{matrix} C_nH_{2n+1} \\ C_mH_{2m+1} \\ CO.HO \end{matrix}\right\} HO\right\} + O = C\left\{\begin{matrix} C_nH_{2n+1} \\ C_mH_{2m+1} \end{matrix}\right\} O + CO_2 + H_2O.$$

As a lactic acid could be obtained from an acid of

* This report was unavoidably excluded from our last number.

the fatty series by acting upon it first with bromine and then with oxide of silver, and as this lactic acid by oxidation ultimately gave the fatty acid below in the series, the process of oxidation furnished a means of converting any acid of the fatty series to the one next below it:

Butyric acid $\left.\begin{matrix} C, C_2H_5, H_2 \\ CO.HO \end{matrix}\right\}$ by this treatment would give

$C.C_2H_5.HO + CO_2 + H_2O$, and isobutyric acid

$\left.\begin{matrix} C.(CH_3)_2H \\ CO.HO \end{matrix}\right\}$ $C.(CH_3)_2O + CO_2 + H_2O$, thus

furnishing a means of distinguishing between these acids. Butyric acid would give first propionic aldehyde, and by further oxidation propionic acid, whilst isobutyric acid would give acetone, acetic acid, and carbonic acid. This application of the principle of oxidation was very important, as the only difference which Frankland and Duppa could find between valerianic acid and isovalerianic acid was the action on polarised light; but by converting them into the corresponding lactic acids and then oxidising them, aldehydes would, no doubt, be obtained which would differ in their physical properties as well as in their chemical constitution.

Dr. Gladstone thanked the author for his very interesting communication, and said that but few chemists thought of trying the action of polarised light on substances, and that no doubt many bodies now supposed to be identical, if submitted to limited oxidation, would be found to be isomeric.

Mr. E. T. Chapman then read another paper, also recording the joint work of himself and Mr. M. H. Smith, "*On the Oxidising Action of Permanganate of Potassium.*" The action of permanganate differed very much according as the solution was neutral, acid, or alkaline. When alcohol was added to an acid solution of the permanganate nothing but acetic acid and aldehyde were produced, the solution becoming quite transparent. In an alkaline solution oxalic acid only was produced, the solution becoming green, and remaining so for some time, binoxide of manganese being precipitated. In a neutral solution of permanganate, acetic acid, aldehyde, and oxalic acid, were produced, manganic peroxide being precipitated, and the solution becoming colourless. A boiling alkaline solution of permanganate of potassium formed a convenient method of distinguishing between tartaric and citric acids—the former completely reducing the permanganate with precipitation of binoxide of manganese, whilst citric acid only reduced it to manganate.*

A paper, entitled "*On the Presence of Soluble Phosphates in Cotton Fibre and Seeds,*" by Professor F. Crace Calvert, was then read by the Secretary, Mr. V. Harcourt:—It was well known that seeds contained large quantities of phosphates, and in analysing them it was usual to ignite the seeds and determine the phosphoric acid in the ash. The author had extracted a specimen of cotton yarn with water, and found a large quantity of magnesia in solution, but not sufficient chlorine or sulphuric acid to combine with it. On testing, however, for phosphoric acid he obtained an abundant precipitate. As the yarn had evidently not been "weighted" with a magnesia salt, he was induced to examine specimens of raw cotton for phosphoric acid and magnesia. Seven samples of cotton from different countries, after being carefully carded, were exhausted with water, and the dissolved phosphoric acid determined after evaporation by means of uranium salt. He found the quantity to vary from ·055 and ·027 per cent. Although there was magnesia present, he had not as yet obtained sufficient evidence to show that the phosphoric acid was actually present in the state of soluble phosphate of magnesium. The exhausted cotton, after ignition, gave traces only of phosphoric acid. Wheat, French beans, nuts, and walnuts, when submitted to the same treatment, gave evidence of the presence of a large quantity of phosphoric acid and magnesia.

* See LABORATORY, note, p. 39 (April 20).

THURSDAY, MAY 2.

Dr. W. H. Miller, F.R.S., in the chair. Owing to an insufficient number of voters at the last meeting, the names of Messrs. Beale and Coleman were read again "for the first time." Messrs. Brough and Petterson were balloted for and elected Fellows. Messrs. W. and G. R. Gowland and Mr. Packard were also balloted for, but not elected. An interesting discussion on Atomicity was commenced by Dr. Odling, and was carried on by Professors Williamson, Miller, Foster, and others. [A full report in our next.]

CORRESPONDENCE.

TITRATION OF ETHERS.

To the Editor of THE LABORATORY.

SIR,—I learn from Mr. Dittmar's report, in your last week's number, that I effect "the decomposition of the ether by heating it for *a few hours* with alcoholic potash in an open flask," and, a line or two further on, that my method is "only applicable in a limited number of cases."

Both statements are the products of Mr. Dittmar's imagination. As a matter of fact, the heating with alcoholic potash takes only a few minutes in ordinary cases, and a determination of the purity of a specimen of acetic ether may be made in about twenty minutes, including the time taken in weighing out the ether for the experiment.

I have applied my method to formiate, acetate, butyrate, valerianate, oxalate, diethoxalate, and benzoate of ethyl, and to valerianate and acetate of amyl; and in all these instances no difficulty has been experienced, and I do not suppose that there are any difficult cases.

With regard to the attack of the glass vessel by alkaline solutions referred to by Mr. Dittmar, I would repeat, as I stated in my paper, that an *alcoholic* solution of potash will bear a short digestion in in a glass tube at 100° C., or a three weeks' keeping in a well-stoppered bottle at ordinary temperatures, without altering in degree of alkalinity.

J. ALFRED WANKLYN.

London Institution,
April 29, 1867.

HISTORICAL STUDIES.

GEBER.

1. THOUGH the attempt to fix a date at which the science of chemistry actually began, has been often made and as often baffled, and though historians now perceive that unless within well-defined limits such an attempt is futile, we need not, therefore, despair of Chemical Antiquities, or refuse to inquire under what form and guided by what idea chemistry appears during any epoch. While we do not sympathise with that spirit which prompted the older chemical writers to enrol scriptural, classical, and mythological celebrities among the adepts, and which, though laughed at in them, is still so active in detecting anticipations or confirmations of the most modern discoveries and theories in the labours or words of some great thinker who lived years or maybe centuries ago, neither do we quite agree with those, who, by affirming that the science began with Lavoisier, or with Black, or with any single chemist whatever, would refuse that name to those who worked at it during a still earlier time.

2. Modern historians are agreed in believing that, though it is difficult, if not impossible, to say at what rate chemical knowledge grew, and when it first received a systematic form, the period at which, and the person by whom, the earliest extant system was published are determined—GEBER being the author, and the eighth century the period. This fact of his being the earliest writer who gives expression to ideas which stand in historical connection with those of the present—of being, in fact, the first chemist who remains for us—invests him with a special interest, which would justify any endeavour to ascertain what his opinions exactly were; but when we find that several of his works are not more remarkable for their age than for their contents and style, for the reputation they bore, and for the tone of the criticism passed on them during centuries, the interest which their author excites is proportionately intensified. The means, however, at our disposal for gratifying curiosity are scanty in amount and disappointing in character. At the best, only fragmentary notices of him have appeared; for while one historian gives an account of his life and a list of his works, omitting all notice of their contents, another quotes largely from the writings, but at the expense of the bibliography or life; and the fullest and best account of all, Dr. Kopp's, does not contain the most recently published biographical notice, and is deficient in the list of the editions. Were nothing more required than to construct a complete narrative out of these fragments, the task would be simple enough; but minuter inquiry into the chief published sources serves only to show how much has to be done before we can be said to be critically acquainted with the life and works of Geber. The following is an attempt—as complete as present circumstances will permit—to restate what is known of Geber. It is not intended to be either exhaustive or final, for subsequent increase of knowledge may so alter the worth of present statements as to involve a corresponding change in the inferences, if not a reversal of them; the results, in the mean time, may be of interest to those concerned with the history of chemistry.

I.—*His Life.*

3. Chalid Ben Jesid—who might be supposed familiarly known to Europeans as Prince Calid or Kallid, the reputed author of the 'Liber Trium Verborum,' but for a discrepancy in dates—has the following verse upon a fact in his own life:

"To wisdom I was invited by Dschabir, the blameless Imam. May the earth press lightly upon him, like the odour of musk."

4. Chalid died A.D. 702, and, if we accept his statement, there must have been a Dschabir in the seventh century who instructed him in that chemistry in which he was an adept. Hammer-Purgstall published this account in 1804,* and virtually repeated it in 1819† when he wrote that one of the three greatest alchymists in Islam was Dschaber Ben Hajan Es-sofi, the pupil of Dschaafer the Imam, and the master of Chaled Ben Jesid. It was only later‡ that he produced the fuller biography of this Dschaber Ben Hajan from the 'Fihrist,' which, however, instead of throwing light upon his personalty, only illuminates the difficulties his biographer has to encounter. In the history he is entitled El-Dschabir—in full (Ebu Abdallah) Dschabir Ben Haijan Ben Abdallah el-Kufi—and is stated to have flourished in 765.

5. Ibnon-Nedim, the author, then proceeds: "El Dschabir, distinguished as ess-Sofi. The opinions about him are various—some saying

* 'Literaturgesch. der Araber,' Wien, 1851, vol. ii, p. 185. He there refers to his 'Encykl. Uebersicht der Wiss. des Orients,' 1804, p. 519.

† Ersch u. Gruber, 'Allg. Encyc.,' ii, 417, Leipz., 1819. The statements were afterwards repeated by Hoefer, 'Hist. de la Chim.,' i, p. 308, Paris, 1842.

‡ 'Literaturgesch. der Araber,' vol. iii, p. 293 sqq. In a note he remarks that the translation had been already published in the 'Jahrbücher der Literatur,' vol. cxiv, p. 169.

he is one of the seven great masters to whom is assigned the charge of the houses of the seven planets, as that of Mercury to Hermes; others, that he was a companion of the Imam Dschaafer ess-Sadik, and resided in Cufa; others accounted him a philosopher, because he left works on philosophy and logic; while the masters of the art (the alchymists) refer back to him the magistery of it in his time. It is their belief that he travelled from country to country, without taking up his residence permanently in any, for fear of falling into the hands of the rulers. It is said that he was particularly attached to Dschaafer Ben Jahja, in the train of the Barmecides; whereas the Schii [a certain sect] maintain that his patron was not Dschaafer the Barmecide, but Dschaafer ess-Sadik the Imam. One of the most trustworthy masters of the art informed me that Dschabir dwelt at Damascus in the main street of the Golden Gate, but that he spent most of his time at Cufa, where the purity of the air assisted him in the preparation of the elixir; that at Cufa a golden caldron, weighing two hundred 'rothl,' was dug up in the ground where formerly the house of Dschabir Ben Haijan had stood, and that this happened in the time of Ised-dewlet, son of Moised-dewlet. Ebu Sebutekin Destardar told me, however, that he could not agree to this. Many scholars and book-dealers affirm that nothing certain is known about Dschabir; others say that he never wrote anything himself, but that the books which pass under his name were compiled by other people and ascribed to him; but I say, a man of merit sits toiling in the composition of a work of thousands of pages, his genius and his thought exhausted in the elaboration thereof, and his hand and spirit in the copying, and then it goes to others who never trouble themselves whether the author has been actually engaged with it or not. This carelessness is a kind of ignorance, which can never be felt by those who have been busied even for an hour with science. But of what use and profit is all this? The man (El-Dschabir) really lived; his existence is patent and renowned; his works are great and numerous. He left books on the sects of the Schii, to which we referred in the proper place; he wrote treatises on the scope of different sciences, which we have duly quoted. He was from Chorasan, it is said, and er-Rasi (Rhazes) says of him, 'Our master, Ebu Musa Dschabir Ben Haijan; his scholars are El-Charki, Ibn Ajadhel-Missri, and El-Achmimi.' Now follow the titles of his chemical works, the number whereof amounts to more than a thousand, of which, however, we shall quote only those which we ourselves have seen, or of the existence of which we have been assured by credible witnesses."*

6. Hammer-Purgstall, in a very brief review of the authorities, notices their discrepancies, but, whether from considering a solution impossible, makes no attempt to reconcile them, and merely remarks that around Geber or Dschabir there hangs a gloom very hard to be dispelled. Chalid's words are precise enough, but then Ibnon-Nedim makes mention of only one Dschabir, who flourished a century later, and the writers who succeeded them also disagree. It could hardly be possible that there should be distinguished chemists of exactly the same name within a century of each other, one the master of Chalid and the other, as some say, his pupil, and that the coincidence should escape the author of the 'Fihrist.' And yet, when the account in that work, as given by Hammer-Purgstall, is considered, one can refrain with difficulty from concluding that, if all these disputed stories were current so soon after the period in which the subject of them lived, they could have sprung up from time to time only by confusing two or more persons under one name, or from other causes which need not now be divined. Were we to suppose that in transcription the names of El Dschabir es Sofi might possibly have become confused with that of the Imam El Dschaafer ess-Sadik, and to try to remove the difficulty by assuming the latter as the master of Chalid and El Dschabir, who would thus be contemporaries, we should be proposing what, with everything in its favour, would be a mere hypothesis, but as it stands is in opposition to all the apparently well-established dates. Wüstenfeld, indeed, according to Theile,† has proved that two chemists of the eighth century are included under the name Geber, and modern statements seem to bear out the affirmation. Of one of these the full name was Abu Abdallah Dschafer Ben Muhammed Ben Ali el Sadik; of the other, Abu Musa Dschabir Ben Hajjan Ben Abdallah El Sufi el Tarsufi el Kufi. The former—who seems to be identical with Dschaafer ess-Sadik of the 'Fihrist' was born, he says, in 699 (three years before the death of Chalid) and died in 765 at Medina, while the latter—who is the Geber of Europeans—was born at Tarsus. It does not seem, however, to have been the custom of native scholars to regard Dschaafer

* The whole of this cannot have been taken from the 'Fihrist' because mention is made of Ised-dewlet, who died A.D. 978, and of Rhazes, who died A.D. 932, whereas that work was composed in A.D. 886. Hammer-Purgstall, however, does not point out where the translation ends, and other authorities are introduced.

† Theile, in Ersch und Gruber, 'Allg. Encyc.,' vol. lv, p. 202, Leipz., 1852. From not having Wüstenfeld's work at hand ('Gesch. d. Arab. Aertze u. Naturforscher'), I am unable to check this remark, or to say upon what authority it is made.

ess-Sadik as a chemist, though he cultivated the science, but rather as a mystic, and the founder of occult learning amongst the Arabs, whereas El Dschabir was viewed as their principal authority in chemistry, to be compared with whom was one of the great distinctions that could be conferred on any other adepts.* But though this identification of persons is proved, the account gives no explanation of El Dschabir's connection with Chalid, which is the point to be elucidated. It seems rather to confirm the difficulty by assigning Dschaafer ess-Sadik the year 765 as that of his decease. For that is the only date mentioned by Hammer-Purgstall in connection with El Dschabir; and if the master lived upwards of sixty years after the death of Chalid, the scholar must necessarily have been still later; and if he is to be allowed time for the composition of the thousand writings ascribed to him, he may have witnessed the close of the eighth or the early years of the ninth century, instead of having lived and worked in the seventh.

7. If this last view could be established it would coincide with what may be termed the second biography of Geber, which has been repeated by most subsequent writers on the authority of Abulfeda the historian.† Abou Moussah Djafar al Sofi, he says, flourished toward the end of the eighth or beginning of the ninth century. He was a native of Harran, in Mesopotamia, and was by religion a Sabæan. This very brief notice is of value because it still adheres to the eighth as the century in which Geber lived, and because it yields a clue possibly to the chief point in the account given by Leo Africanus.‡

8. That traveller, having visited the city of Fez, in Africa, devotes a large portion of his travels to describing its principal characteristics, among which were its alchemists; it is in this narrative that the third biography of Geber is contained, which, like the preceding, has been quoted by most historians. It is fortunate that Leo Africanus was by no means a partisan of the adepts, otherwise we might never have obtained the glimpse he gives us into their life in the fifteenth century.

"In this city there is a vast concourse of alchemists who prosecute their vainest art. They are a set of the stupidest fellows, for they mummify themselves with sulphur and other horrible stinks. According to their wont, they assemble in the evening in the chief temple, and there discuss their false doctrines. They have a great number of books written by learned men, the chief place among whom is assigned to a certain Geber, who flourished a hundred years after Mahomet [that is, in the eighth century], and was, they say, a Greek who abjured his faith. His treatise and all his dogmas are couched in allegory." There were two sects or societies in this place, but the aim of both, continues the traveller, was the same, namely, to coin bad money, on which account most of the "fellows" [as they would be styled now] might be found with one hand lopped off. Such was then the punishment of forgery, but he may have used a traveller's licence in regard of the number of victims; and though still many may have been mutilated, we may hope that they suffered for the misdeeds of the few, for the maimed alchemists were not on that account necessarily forgers, though they may have had experience as metallurgists.

9. This report of Leo Africanus seems to Dr. Schmieder* to be confirmed by its own intrinsic probability, and upon it he has constructed a theory to explain what would otherwise be a difficulty connected with Geber's name and writings. He remarks, correctly, how singular it is that the earliest writings on chemistry should be so full, clear and accurate, and yet should have emanated from a nation of so little experience as the Arabs, who were indebted, as their own historians affirm, for almost all their knowledge and culture to Greek and other foreign sources. The difficulty, however, at once disappears if Geber was a Greek, who, when converted, would carry all the skill of his nation along with him. His name itself bears evidence, he thinks, of other than oriental origin, for it is always written Dschefer or Dschafar, Jeber, Yeber, Heber, Giabar, Geber, or with some similar variation, but without any titles to show that its owner could boast of long descent, or of any Islamitic descent at all. To substantiate this view he quotes a tradition to the effect that Mahomet, when busied with his great work, was assisted by a learned Greek named Jabar or Yefar, in the composition of the Qoran. This legend was so distasteful to the most faithful Faithful that they rejected it with anger, and used his name subsequently as a vile epithet of all unbelievers, one form being Guebre, applied to the fire worshippers, and Giaour another, conferred on the Christians, from which Giabr, or Geber, is not very divergent. Thus, the Greek chemist may have retained the approbrious title of all heretics after his conversion, whatever his name as a

* Thus, Ibnol-Kofthi says of Zul Nun, that in chemical knowledge he might be put on a level with Dschabir Ben Haian. Casiri, 'Biblioth. Arab-Hisp. Escurial,' i, p. 441, Madrid, 1760.

† Abulfeda ('Ann. Musl.'), ii, 22: referred to by Sprengel, Hist. de la Médecine,' ii, 263, Paris, 1815; and Hoefer, 'Hist. de la Chimie,' i, 309.

‡ 'Africæ Descriptio,' iii, p. 136; and Lugd. Batav., 1632, p. 352.

* 'Geschichte der Alchemie,' 1832, pp. 86–94.

Christian may have been, and that which was at first contemptuous may have afterwards had the sting extracted by his abilities, though it could never receive additional onomastic decorations, but would remain his special appellative and pass on to posterity as a proper name.

As a necessary consequence of this theory, its author assumes the existence of a younger Geber, to whom appertains strictly that longer name found in most historians, and which is quoted by Du Fresnoy on the authority of certain manuscripts.* Schmieder supposes that Geber the younger was a son of the convert; that his name was originally Abu Mussa Giaber, to which later writers, perhaps his scholars, appended the words Ben Hajiam al Sofi in order to distinguish him from his father. This title, he thinks, is simply Greek, and signifies "Son of the Venerable Sage," υἱός ἁγίου τοῦ σοφοῦ; while Ebn Haen of some writers is merely a variation in spelling, and the epithet Tusensis Souficus, found in one of the aforesaid manuscripts, a translation, with the name of his birthplace or residence attached.

10. Professor Poggendorff, who has taken the pains specially to refute the main theme of Schmieder's history,† has yet given currency to his theory of an elder and younger Geber‡ and it has been recognised, though not formally, by Dr. Kopp.§

There seem to be reasons, however, for accepting it with great caution, if not for rejecting it altogether. Since Schmieder has apparently left his readers to infer that it is on facts mentioned by Du Fresnoy that he bases his hypothesis, it may be observed that that author himself says nothing about two Gebers, and distinctly remarks that the name is not of Greek origin.|| It would be out of place here to enter into the etymological argument at all, and we can fortunately dispense with it, for there are sufficient proofs from other sources. In one of the manuscripts to which he refers, the possessor of the longer name is explicitly identified with Geber—Abou Moussa Giaber ben Haijam al Sofi, qui vulgo Geber nuncupatur.¶ This, which may be a gloss by a later hand, corresponds both with the names given above and with those mentioned by writers who know of only one Geber. Rhazes** calls him "filius Ayen," Ibnol Kofthi†† cites the great chemist under the name Dschabir ben Haijan, Haji Khalfa* calls him still more ornately Abu Musa Jabir Ben Hayyan Et-Tarsusi (Et-Tusi or El-Maghribi) El-Kufi Es-Sufi. And though by the older medieval authors such a name was, naturally enough, cut down to plain Geber, one at least calls him Geber Arabs Ebenhaen.† This by itself would prove nothing; but when he is referred to as the author of the 'Sum of Perfection,' the chief treatise ascribed by all, Schmieder included, to Geber the renegade, we must either conclude that the elder Geber was passed over in silence by the biographers, and his writings universally ascribed to Geber the younger, or else that there was only one Dschabir, and that some other inference is to be drawn from Leo's account rather than that which Schmieder has given. It is curious that Schmieder has referred to Leo's narrative only, and has taken no notice of that of Abulfeda, of which he can scarcely be supposed ignorant. Since, however, he has chosen to abide by this one account, which is doubtless truly reported by Leo, it would require to be proved how much reliance can be placed upon a tradition which refers to a time so long anterior to that of its own circulation, and which may have arisen from Geber having been a Sabæan, as Abulfeda reports. For the creed of that sect is said to have been a mixture of Judaism and Mahommedanism, and it is as likely that misunderstanding prevailed with regard to the constituents of his original religion as that there should have been two Gebers, father and son, both chemists, the latter of whom is spoken of by none of the principal authorities. It is not obvious what inducement Schmieder has had to advance an hypothesis which is not confirmed either by authority or by circumstance, which explains nothing when accepted unconditionally, and is successful only in having nothing to explain. For the discrepancy between Leo's information and the Paris manuscript can be got over in a simpler manner than by the creation of a new chemist. There *is* a difficulty connected with the authorship of the works we have, but it springs from their own qualities, not from their being either of Greek or of Arabian origin. But once granting that the works are as old as they are masterly, there was nothing to prevent the author from being an Arab who had studied in Greek sources, who had imbibed their spirit and their power, and who in his treatises concentrated their knowledge, and reproduced, as he himself says, the lore of "the ancients." Arabs there were who had translated Greek books for their caliphs. Why may not Geber have been one of these?

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* 'Hist. de la Philosophie Hermétique,' Paris, 1742, vol. i pp. 29, 31.
† 'Handw. der Chemie.,' Art. "Alchemie," vol. i, 1837.
‡ 'Biogr. Liter. Handw.,' i, column 865, Leipz., 1863.
§ 'Geschichte der Chemie,' vol. i, p. 52, Brunswick, 1843.
|| 'Hist. Phil. Herm.,' i, p. 74.
¶ Ibid., iii, p. 29.
** Vid. supra in the 'Fihrist.' Quite independently, Hoefer quotes from an unpublished MS. of Rhazes to the same effect. 'Hist.,' i, 309, and note (4).
†† Casiri, 'Bibl. Escur.,' i, 423.

* Haji Khalfa, passim, ed. Flügel, 1835—1858.
† Zetzner's 'Theatrum Chem.,' 1613, vol. i, p. 1.

11. Seeing that there is such discordance in the original sources from which all that is known of Geber is derived, it need hardly be said that modern historians do not harmonise more completely. In fact, by introducing more recent statements and by repeating variations in dates and in the spelling of the name, they would appear to have no intention of agreeing. Drs. Kopp* and Hoefer,† the most recent and complete writers on the subject, give the accounts both of Leo and Abulfeda; Thomson,‡ who translates without special acknowledgment from Sprengel,§ quotes the statement of Abulfeda alone. Schmieder, as we have seen, relying upon Olaus Borrichius,‖ confines himself to that of Leo Africanus. Gmelin,¶ curiously enough, does not repeat even it, though he knew that old historian well. These authors in their turn have their results reproduced in the biographical dictionaries. It will be sufficient to mention the additions which have been made to the original accounts, for though they are of no direct value, they may be possibly brought hereafter into connection with them, or may assist in opening any new source of information respecting Geber.

12. By some he is reported to have been descended from Mahomet by the mother's side, and in this spirit, apparently, a fanciful dialogue** between Geber and Demogorgon begins with an exclamation of the latter, "Hail, most sapient grandson of mighty Mahomet." This person is supposed to have been the prophet, but others think that he was an alchemist, and Gesner says,†† "the grandson of I know not what mighty Mahomet"—a display of modest caution which it may be prudent to imitate. Of more importance is the assertion that he was a native of Spain, but of Arabic parents. Nicolas Antonio, according to Du Fresnoy,‡‡ seems to have propagated, if not originated, this belief, but without establishing it by satisfactory arguments. In accordance with it he was claimed as a native of Tortosa, from confusing this place with Tarsus; §§ while by others he was believed to have been born in Seville, in Andalusia, or to have migrated thither from Thus, in Khorassan, and to have devoted himself to teaching all the branches of Græco-Arabic philosophy, and to founding a school of chemistry, the doctrines of which soon spread throughout civilised Europe. In this city he is reported to have died in the year 765, which corresponds very closely with the dates already given and with 776, which, according to Haji Khalfa, is the year of the decease of Dschabir Ben Haijan.

13. Whether these conflicting accounts have arisen from there having been more than one person of the same name, or whether they have occasioned the belief that there were several Gebers, is a question not easy to settle. The name Dschabir was by no means peculiar to the chemist, as Schmieder might lead us to think, but was borne by literary men of different epochs; passages have been already mentioned in which distinct individuals are included under it;* and, following the same argument, Hammer-Purgstall concludes the 'Fihrist' catalogue of Dschabir's five hundred writings with saying that they are probably the labours of different authors of different periods.†

14. Du Fresnoy‡ speaks of a poet named Geber or Giaber, who flourished at a later age in Spain;§ and though he says he could not possibly have been the chemist, for poetry and chemistry are two follies diametrically opposed, but which require perfect men to excel in either, his name may have served to keep fresh the remembrance of his more notable predecessor, and he even may have obtained credit for writing some of his treatises. There is, however, another Geber, a native of Seville, who flourished in the twelfth century, whose works have generally been mentioned in catalogues along with those of the chemist,‖ and who has been otherwise identified with him,¶ though they are now distinguished, possibly

* 'Gesch. der Chemie,' i, p. 51.

† Hoefer, 'Hist.,' loc. cit.

‡ 'History of Chem.,' vol. i, p. 116, Lond., 1830. But compare page 14: "Geber is supposed to have been a physician, and to have written in the seventh century;" and then follows an outline of his theory, which by no means accords with what is stated subsequently. When Thomson wrote one he must have forgotten all about the other.

§ 'Hist. Med.,' loc. cit.

‖ "De Ortu et Progressu Chemiæ," p. 30, in Manget, 'Bibl. Chem. Cur.,' vol. i, 1702.

¶ 'Gesch. der Chem.,' i, p. 15, Gœtt., 1797.

** Manget, 'Bibl. Chem. Cur.' i, p. 567.

†† Vid. Vossius, 'De Philos.,' p. 117, Hag. Com., 1658.

‡‡ 'Hist. Phil. Herm.,' i, p. 73.

§§ So reports Theile (v. sup., § 6, note †), but there is also a Tortosa in Syria, as well as in Catalonia, and that may possibly have been substituted for Tarsus.

* Supra, § 6.

† 'Literaturgesch. d. Arab.,' iii, p. 299. D'Herbelot ('Bibl. Orient.,' p. 387, Paris, 1697—this article seems to be omitted in the 1781 edition—) mentions three individuals under the name Giaber. The second of these is Dschabir Ben Haijan, and he is described after Abulfeda. He is, besides, called; Son of Senán, and father of Mohammed Al Battani. This latter person was, indeed, distinguished as Ibn Dschabir, and Hammer-Purgstall thinks it not unlikely that some of his writings may have been ascribed to Dschabir himself.

‡ 'Phil. Hermet.,' i, 74.

§ This seems to be the third person mentioned by D'Herbelot.

‖ E. gr., Simler's 'Epitome.'

¶ Whewell ('Hist. Ind. Sci.,' i, pp. 226, 304, 1837) speaks of Geber of Seville as an astronomer and chemist, but without distinguishing them. Again, when Cardan ('De Subtil.,' xvi, p. 573, Basil, 1564) ranks Heber Hispanus among the twelve subtlest geniuses of the world, an opinion that has been handed down to our own day by Geber's enthusiastic biographers, it is most likely to the astronomer that he refers.

with greater accuracy.* Casiri and others refer to him as Geber filius Affla Hispalensis. He is the author of a work on astronomy, and it was he whose comments on Ptolemy are said to have called down the wrath of Copernicus. At the beginning of the commentary he treats of spherical triangles; it would be interesting to know whether the Paris manuscript No. 7399 (Hoefer), ascribed to Dschabir Ben Haijan, is anything more than a copy from that work. Whether or not this writer and the author of the works to be hereafter mentioned were the same, we shall confine ourselves to the chemist, and merely refer those who desire information respecting the astronomer to Brucker's 'Historia Philosophiæ,' and to the histories of Delambre and others.

15. It is a difficult, perhaps an unnecessary, task to arrange such confusion; the contemplation of it only leaves on us the impression that by some channel now obliterated the original oriental narratives, with all their contradictions, infiltrated slowly, but so thoroughly, into the Western traditions, that there is hardly a statement they contain which has not been retained, though with more or less change. Watson expresses a curious doubt whether he preceded or followed Calid,† and even the connection with Mahomet seems to be nothing else than a misinterpreted reminiscence of his patron, Imam Dschaafer Ben Muhammed.

16. Whatever other conclusions may be drawn from the preceding collection it seems certain that, in the interval between the last half of the seventh and the first quarter of the ninth century of our era—and, if 760 be accepted as an average date, some 1100 years ago—there lived an Arab who cultivated the science of chemistry, and who wrote many books upon it. Of everything connected with his life, his birthplace, his parents, his social and political relations, his rank, his actions and adventures, his death, there seems to be neither anything certainly known nor any means of supplying the want—the darkness gathers more thickly around him as time advances. But to those who followed his teaching some few centuries ago, his greatness loomed so mightily through it that they appeared to think a royal title could alone denote him truly. Like some of the points already noticed, this may be merely another reminiscence, a translation, perhaps, of the word Scheik, which native writers have prefixed to his name;‡ it may have been also in part conferred on him by the admiration and awe of those who studied his works; it is incautious, therefore, on one hand, merely to affirm, as has been done,* that there is no warrant for it; and it is unnecessary, on the other, to combat his prerogative, to which some may still deem him well entitled, of remaining "King of the Arabs."

* Hoefer, 'Nouv. Biog. Gén.,' t. xix, sub voc., 1857.
† 'Chem. Essays,' i, p. 18, Lond., 1784.
‡ 'Haji Khalfa, passim.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *April* 29, 1867.

Meeting of the Académie of the 22nd inst.—Jobert de Lamballe. —M. Berthelot's recent researches.

THE meeting of the Académie of the 22nd inst. was characterised by various incidents of personal interest—the announcement of the death of an academician, the nomination of a new member, and the communication of papers by several foreign savants who have been attracted to Paris by the Exhibition, and who were present at the sitting.

M. Jobert de Lamballe died on the 19th inst., after a hopeless mental disease that seized him suddenly twelve months ago. Celebrated as a surgeon, he will be remembered by men of science for a simple observation which has done much to expose the nuisance of spiritualism. Jobert observed some years ago that by an imperceptible movement of the knee noises might be produced which closely resembled those imposed upon the credulous as prophetic "spirit-rappings," phenomena now somewhat out of fashion.

Three new seats having been added by the Imperial decree of the 3rd of January, 1866, to the section of Geography and Navigation, the Académie proceeded to elect a member for the second of these. M. d'Abbadie (known chiefly for his travels in the Brazils) was elected by 29 votes against 28 given to M. Villarceau. The Maréchal Vaillant, already member of another section of the Académie, who had put himself on the list of candidates, deemed it expedient to withdraw his name before the election took place.

Among the strangers present at the sitting we mention Professor Richter, of the School of Mines, Freyberg, Saxony, the discoverer of the latest metal, *Indium*, and Professor Sterry Hunt, from Toronto.

A splendid sample of indium is now exhibiting in the Champ de Mars, and the discoverer communicated a short note on its properties to the Académie. The metal occurs with sulphide of zinc in the mines of Freyberg, 100 kilogrammes of the mineral containing 25 to 40 grammes of indium. It is obtained by treating the residue of the solution of zinc in hydrochloric acid with nitric acid, evaporating, treating with sulphuretted hydrogen, dissolving the precipitate in hydrochloric acid, separating from copper, zinc, and cadmium, by ammonia, and reducing the oxide by heating it in a current of hydrogen. The metal is very white, soft, and ductile. It has a specific gravity of 7·15, and an equivalent of 35·9. Prof. Richter described some of its salts as well as its spectroscopic reaction. We learn from private sources that Professor Regnault is now occupied in determining the specific heat of indium.

* Hoefer, 'Nouv. Biogr. Gén.,' t. xix, col. 789.

A note *On the Formation of Gypsum and of Dolomites*, by Prof. Sterry Hunt, was read by the author himself. The following are the results of his experiments:—Bicarbonate of calcium, contained in almost every specimen of water, and sulphate of magnesium (a constituent of sea-water), will give, by double decomposition, sulphate of calcium and bicarbonate of magnesium. All carbonates are originally formed by the action of atmospheric carbonic acid on silicates. The carbonate of sodium thus formed decomposes the chloride of calcium of sea-water. Only sea-water that has been previously deprived of all its lime will give carbonate of magnesium by double decomposition. This accounts for the scarcity of carbonate of magnesium unaccompanied by gypsum. An account remains to be given on the formation of dolomites, or combined carbonates of calcium and magnesium. This combination is effected by heating up to 120°—150° the mixed carbonates of calcium and magnesium, as formed by the action of carbonate of sodium on the two chlorides. Carbonate of magnesium partially decomposes gypsum, but bicarbonate of magnesium has not the same effect. The atmosphere of primitive times, containing much more carbonic acid than our own, was therefore particularly favorable to the separation of gypsum from mother-liquors.

M. Tresca, who has been occupied for some time with the study of the shape assumed by solid bodies when pressed with great force through small openings, communicates an account of his researches.

M. A. Perrot, from Geneva, having previously described a very practical gas-furnace for producing high temperatures, now reports the following results. To fuse 5 kilogrammes of copper, 1500 litres of gas have been consumed; for 5 kilogrammes of gold, 400 litres of gas were found sufficient. The inventor likewise succeeded in fusing nickel in his furnace.

M. Berthelot publishes the end of his communication on reducing and saturating with hydrogen organic compounds. This paper, in spite of its interest and its extraordinary length, may be condensed into a few words. Prof. Berthelot treated a great variety of bodies with hydriodic acid at between 250° and 300°, obtaining, as a general result, the saturated hydrocarbons corresponding to the number of carbon-atoms contained in the combination which he submitted to this reaction. It is necessary that the acid should have a specific weight of 2·0, and that a great excess should be employed. An acid weighing 1·2 proves to be too weak. For most bodies belonging to the fatty series 20 or 30 parts in weight of the acid will suffice. For aromatic bodies 80 or 100 parts are required; for carbon and carbonaceous matter, even more than that becomes necessary. This excess is evidently required to counterbalance the decrease in strength the acid undergoes during the reaction, and it would most likely be possible to avoid it if care were taken to transform the iodine liberated into hydriodic acid, by adding phosphorus, as proposed by MM. de Luynes and Salet. The reaction is of course without influence on saturated hydrocarbons.

Hydrocarbons of the general formula $C_{2n}H_{2n}$ (old atomic weights) are transformed into hydrocarbons of the general formula $C_{2n}H_{2n+2}$. By first heating to 100°, ethylene is transformed into iodide of ethyle which at 250° undergoes the reaction $C_4H_5I + HI = C_4H_6 + I_2$. Acetylene, allyle, etc., behave in the same way. So does chloride of carbon:

$$C_4Cl_6 + 12HI = C_4H_6 + 6HCl + 6I_2.$$

We call the reader's attention to the fact that M. Berthelot, although keeping to old atomic weights, never writes a formula with an uneven number of corbon- or oxygen-atoms, and even admits the molecule of iodine to be $= I_2$. The old adversary is evidently gradually accepting the new theories. Alcohols and fatty acids conform to the rule, acetic acid giving C_4H_6; but formic acid forms an exception, being transformed into oxide of carbon and water. Succinic acid forms the corresponding hydrocarbon C_8H_{10}.

Aldehydes yield not only the corresponding hydrocarbons, but also higher ones formed by the condensation of several aldehyde-molecules. The same reaction takes place with aromatic bodies, benzol, $C_{12}H_6$, being transformed into hydride of hexyle, $C_{12}H_{14}$. If, however, an insufficient quantity of acid is employed, then all aromatic bodies are decomposed into carbon and lower carbides, thus—

$$C_{12}H_6 + 6HI = C_6H_8 + 3C_2 + 2H_2 + 3I_2.$$

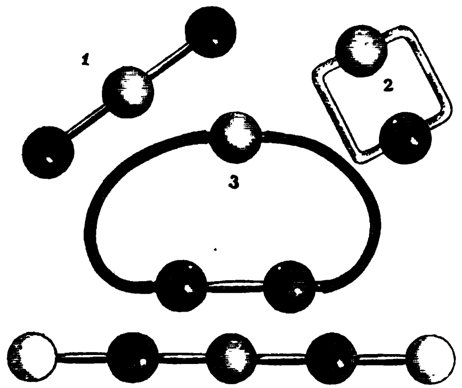
Chloride of benzol and chlorinated benzol, $C_{12}H_6Cl_6$ and $C_{12}Cl_6$, both give benzol. Benzoic acid, according to the quantity of acid employed, gives $C_{14}H_8$ or $C_{14}H_{16}$. Bodies containing nitrogen give ammonia and saturated hydrocarbons. Hydrocyanic and aqueous hydriodic acid give iodide of ammonium and carbonic oxide. But cyanide of mercury and gaseous HI give marsh gas. Cyanogen gives carbon when heated with gaseous acid; but hydride of ethyle gives carbonic acid and oxide when treated with an aqueous solution. Indigo yields $C_{14}H_{16} + C_2H_4$. Albumen forms a great number of inactive hydrocarbons like those contained in petroleum. Complex hydrocarbons, such as naphthaline and anthracene, yield a great variety of products. The former yields hydride of decylene, $C_{20}H_{22}$, hydride of hexylene, $C_{12}H_{14}$, also $C_{20}H_{10}$, hydride of naphthaline. This body is new to chemists; but M. Berthelot does not exactly describe its properties, nor does he publish an analysis of the same. The total want of analytical proof in the papers hitherto published is rather bewildering to those who know the extreme difficulties attending the separation of hydrocarbons, a great number of which were formed either simultaneously or by changing the conditions of the reaction of HI on complex hydrocarbons. It is true that a lifetime might have been spent in furnishing the arguments generally admitted as requisite to leave no doubt as to the formation of the enormous quantities of bodies obtained in these reactions, many of which we are obliged to leave unnoticed for want of space. One of the most unexpected reactions observed by the learned and indefatigable experimentalist is that given by carbonaceous matter and by carbon itself. They all form saturated hydrocarbons with from 12 to 24 (old) carbon-atoms. The interest attaching to this research is very great, and such remarks as we have ventured to bring forward are by no means intended to decrease it. Still, we must not omit to mention that

similar reactions have been published by Carius, who observed the transformation of benzol into iodide of hexyle, and by Scheurer-Kestner, who observed that aniline in the process of its formation is sometimes reduced to benzol and ammonia.

EDITORIAL NOTES.

GLYPTIC FORMULÆ.

THOSE teachers who think, with Dr. Frankland and Dr. Crum Brown, that the fundamental facts of chemical combination may be advantageously symbolised by balls and wires, and those practical students who require tangible demonstration of such facts, will learn with pleasure that a set of models for the construction of glyptic formulæ may now be obtained for a comparatively small sum. At first sight, the collection of bright-coloured and silvered balls suggests anything but abstract chemical truth, and a very young philosopher might excusably convert them to purposes of exclusively recreative science. There are seventy



balls in all, for the representation of atoms—monads, dyads, triads, tetrads, pentads, and hexads, being distinguished by the numbers of holes pierced in the balls. To connect these box-wood atoms into "rational formulæ," brass rods, straight or bent, and occasionally flexible bands, are employed. The figures that may be formed by the combination of these coloured balls are very striking, and are more likely to rivet the attention of students than chalk symbols on a black board. Whether they are calculated to induce erroneous conceptions is a question about which much might be said. In our diagram we show how four simple compounds comprising only univalent and bivalent elements are represented. Fig. 1 may stand for chloride of barium, $Ba''Cl_2$; fig. 2, baryta, $Ba''O$; fig. 3, peroxide of barium, $Ba''O_2$; and fig. 4, hydrate of barium, $Ba''H_2O_2$. Of course those compounds containing elements of higher atomicity are represented by much more complicated aggregates of balls and rods, and sometimes the india-rubber connections have to be stretched to their fullest extent to express Dr. Frankland's very elastic bonds. The maker of this box of models is Mr. Blakeman of Gray's Inn Road.

ABSORPTION OF HEAT BY AQUEOUS VAPOUR.

THE recent experiments of Magnus, which are brought before our readers in an abstract of a paper contributed to 'Poggendorff's Annalen,' seem to imperil a very beautiful fabric raised by our English physicist, Tyndall. To the "mighty power" with which aqueous vapour can absorb the non-luminous rays the latter has ascribed most important consequences, and the experiments by which he established this power were apparently conclusive. Magnus, however, has consistently maintained that there is no essential difference between the absorptive power of moist air and that of perfectly dry air, and he now believes he has discovered the imperfect link in Tyndall's chain of reasoning. The truth cannot long remain hidden from either of these careful investigators. Meanwhile, students of physics can take their choice of the following propositions:

"Weight for weight, aqueous vapour transcends all others in absorptive power."—(Tyndall).

"Aqueous vapour has no very great power of thermic absorption."—(Magnus.)

CHEMICAL TEXT-BOOKS.

IT is a matter much to be regretted that the text-books on Chemistry ordinarily in use differ so widely in their statements respecting those subjects which are included in the lower scientific examinations. The examiners, as well as the students, have to "grind" in order to master the eccentricities of certain popular manuals. An examiner in Chemistry may be startled by the student's statement that nitrogen is prepared by heating nitric acid on raw butcher's meat, but this delicate process is gravely prescribed in a much-used text-book. Again, he must be prepared to encounter ignorance as to the ordinary and most convenient process for preparing chlorine, as this process has been entirely overlooked by the writer of one of our most recent handbooks. If the student has got up his chemistry from a little treatise lately written by a leading

chemist, he will probably know nothing of the ordinary process of preparing the important medicinal salt, iodide of potassium. If he has dipped deeper into chemical literature it, is not unlikely that he will state that carbonic oxide may be conveniently prepared by heating powdered chalk and iron filings in a gun-barrel, as this is the mode of preparation to which prominence is given in one of our best treatises.

ROYAL SOCIETY—NEW FELLOWS.

At a meeting of the Royal Society held on Thursday evening, the following gentlemen were selected as Fellows, to be balloted for on June 6, from a list of sixty candidates:

William Baird, M.D.
W. Boyd Dawkins, Esq.
Baldwin Francis Duppa, Esq.
Albert C. L. G. Günther, M.D.
Julius Haast, Esq., Ph.D.
Capt. Robert Wolsely Haig, R.A.
Daniel Hanbury, Esq.
John Whitaker Hulke, Esq.
Edward Hull, Esq.
Edward Joseph Lowe, Esq.
James Robert Napier, Esq.
Benjamin Ward Richardson, M.D.
J. S. Burdon Sanderson, M.D.
Henry T. Stainton, Esq.
Charles Tomlinson, Esq.

Our readers will be glad to see that Mr. Duppa, who is so well known for his synthetical researches, made conjointly with Dr. Frankland and with Mr. Perkin, has been selected. Those who are interested in Materia Medica and therapeutics, will notice with pleasure the names of Mr. D.Hanbury and Dr. B. W. Richardson on the above list.

Among the unsuccessful candidates were several very eminent men, notably Mr. J. A. Wanklyn, whose European reputation as an original investigator in organic chemistry, ought surely to have been recognised by our great scientific body.

FUTURE ARTICLES.

In our next will appear an original paper by Dr. Matthiessen, on the Determination of the Co-efficients of Expansion caused by Heat, in continuation of his series on Alloys. The publication of this paper has been delayed by the preparation of several elaborate engravings. In the same number will be commenced Practical Notes on Fruit Essences and Artificial Odours, by H. N. Draper, F.C.S. The conclusion of Mr. Barff's article on Silicious Painting, and Dr. Frankland's third lecture on Coal Gas, will be published immediately.

ORIGINAL COMMUNICATIONS.

DR. M. SIMPSON ON DI-IODACETONE.

On the Formation of Di-iodacetone. By Maxwell Simpson, *M.D., F.R.S.*

Many years ago Sir Robert Kane discovered that, when acetone is subjected to the action of chlorine, a body is formed having the composition $C_6\left\{\begin{matrix}H_4\\Cl_2\end{matrix}\right\}O_2$,* which he called mesit-chloral. It is now, however, generally known by the name of di-chloracetone. The nature of the reaction which generates this body is explained by the following equation:

$$C_6H_6O_2 + 4Cl = C_6\left\{\begin{matrix}H_4\\Cl_2\end{matrix}\right\}O_2 + 2HCl.$$

When the same compound (acetone) is subjected to the action of chloride of iodine, I have ascertained that di-*iod*acetone is formed, and by a perfectly analogous reaction:

$$C_6H_6O_2 + 2ClI = C_6\left\{\begin{matrix}H_4\\I_2\end{matrix}\right\}O_2 + 2HCl.$$

This compound was prepared in the following manner:—A mixture of a weak solution of chloride of iodine in water and pure acetone was introduced into a large glass balloon with a long neck and gently heated. As soon as the temperature of the mixture had reached 70° C., a violent action took place, which resulted in the deposition of a dark-coloured oil. When the action had ceased the oil was separated from the excess of chloride of iodine, washed with water, and afterwards with a very dilute solution of potash, in order to remove the free iodine. Finally, it was again washed with water, dried *in vacuo* over sulphuric acid, and analysed. The experimental numbers correspond sufficiently well with the theoretical, as will be seen from the following table:

	Theory.		Experiment.	
			I.	II.
C_6	36	11·61	11·82	—
H_4	4	1·29	1·72	—
O_2	16	5·14	—	—
I_2	254	81·96	—	80·63
	310	100·00		

Di-iodacetone is a light straw-coloured oil when freshly prepared; it soon, however, becomes red from the separation of free iodine. It is specifically heavier than water; it has a sharp biting taste; it burns the skin and, like acroleine, attacks the eyes, producing intense pain and inflammation. It cannot be distilled

* C = 6; O = 8.

without decomposition. With the view of forming di-cyanacetone, I heated one equivalent of this body with two equivalents of cyanide of silver. I did not, however, succeed in obtaining the desired compound, the principal product of the reaction being acroleine. With the oxygen acid salts of silver it yields acroleine also, together with some acrylic acid.

Dublin, April 30, 1867.

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *April 29.*

In the very elaborate Jury Report on the chemical products displayed in 1862, Dr. Hofmann calls the attention of the manufacturing world to the valuable properties possessed by certain barium compounds, and ventures to prophesy a great future for them. In concluding his exhaustive account of these substances, he expresses a hope that great results will be obtained in this direction during the ensuing decade. Half the period assigned has now elapsed, and, as far as England is concerned, nothing appears to have been done towards realising Dr. Hofmann's hopeful prophecies, only a few barytic compounds, such as the chlorate, nitrate, and chloride, being exhibited.

The metals aluminum, magnesium, and sodium, which at one time seemed likely to take an important position in manufacturing industry, are hardly represented at all. In the philosophical instrument department magnesium is exhibited, but only as an adjunct to Solomon's magnesium lamp; and aluminium and its alloys are quite unrepresented. As in many other cases, one is compelled to suspect that these manufactures are on the decline. It certainly seems hard that when such useful metals as aluminum, magnesium, and sodium, have been once transferred from the laboratory to the manufactory, they should be allowed to drop back into obscurity after having dazzled the crowd with their singular properties. Ultramarine is also absent with a single exception. In Messrs. Gaskell and Deacon's case there is a specimen of blue which is apparently ultramarine, but we have no indication that it is of English manufacture.

Of chromium compounds, there are one or two specimens of chromic acid and bichromate of ammonia, but not a single manufacturer exhibits either bichromate or chromate of potash.

It may be mentioned incidentally that since our last report the Jarrow Company have completed their display. Their caustic soda, soda crystals, and bicarbonate of soda, are worthy of their ancient reputation. They also exhibit good specimens of Jullion's patent anticlor-hyposulphite of lime.

White, red, and orange lead are well shown by Tudor and Sons and Walker, Parker, and Co. They also exhibit flake and ground litharge of ordinary quality, and pure for glassmaking purposes. The latter firm show models illustrating the mode of making white lead by the English system. Zinc and antimony white do not put in an appearance at all.

Arsenic is exhibited by Walker, Parker, and Co., and A. C. Hadland and Co. The latter firm also contribute fine samples of realgar and orpiment. It is singular that nobody exhibits arsenic acid, although enormous quantities are used in the manufacture of aniline dyes. In mercurial preparations Messrs. May and Baker, as usual, take the lead. They unfortunately suffer very considerably from the effects of a huge carpet, which has been placed upon the wall in front of their case. Luckily their specimens may be examined from the side as well as from the front, otherwise most people would suppose that the calomel, carbonate, and nitrate of bismuth, and other white products turned out of the Battersea works, were usually of a fine yellowish-buff. They exhibit calomel and corrosive sublimate in crystalline cakes, the isolated crystals of the latter salt being particularly fine. It seems that in certain parts of Russia and Turkey the white calomel obtained by the usual steam process is quite unsaleable; a certain quantity of the crystalline product has consequently still to be made. Of the other mercurial preparations we have the red oxide, the yellow protonitrate, the subsulphate, and several others. Carbonate and trisnitrate of bismuth are also shown—the crystals of the trisnitrate being particularly fine. In miscellaneous products we have cyanide of potassium, both in lump and in sticks. Every amateur photographer who has tried to break a refractory lump of this salt will appreciate the value of being able to purchase it in the latter form. Chloride of zinc, oxide and oxysulphide of antimony, conclude the metallic compounds displayed by Messrs. May and Baker. A magnificent crystallisation of metallic bismuth in this case attracts great notice, both from scientific men and the general public.

Messrs. Davey, Yates, and Routledge exhibit fine but small specimens of corrosive sublimate and calomel, also the biniodide, persulphate, and subsulphate of mercury. Their bromide of cadmium, valerianate of zinc, and citrate of bismuth and ammonia, are of excellent quality.

Messrs. Howards and Sons exhibit calomel and corrosive sublimate of the finest quality.

Mr. Condy exhibits his well-known disinfecting fluid, and in addition a very interesting, though small, series of permanganic compounds. First amongst these may be mentioned the permanganate of ammonia, which was long said not to be capable of existing in a separate form. Mr. Condy has, however, succeeded in forming this compound, and exhibits it in small but well-defined crystals. Side by side with it we find the permanganates of potassium, sodium, calcium, barium, silver, and zinc.

Mr. Condy at first exhibited a solution of permanganic acid, but even the small quantity of light that penetrates through the thick blinds of Class 44 caused oxygen to be liberated in such quantities that the bottle burst, sending the stopper and part of the neck through the top of the case like a bomb-shell, with an

explosion that seriously disturbed the equanimity of all the *sergens de ville* in the neighbourhood for several days after. There would be no need to allude to this unfortunate accident, had it not been industriously rumoured that it was the permanganate of ammonia that had so seriously interfered with the gravity and placidity of the guardians of the peace of His Majesty the Emperor.

The salts of tungsten do not seem to be exhibited at all. Incombustible starch appears in Messrs. Rickett's case, but no information is given as to whether it is prepared with tungstate of soda or not.

Silicate of soda of fine quality is exhibited by Mr. Gossage, and has been before alluded to in our account of that gentleman's new soda process.

The very important manufacture of bisulphide of carbon is wholly unrepresented. Chloride of sulphur is also absent. Phosphorus, and, above all, lucifer matches, likewise came under the same category. It is really painful to be obliged to write this very objectionable word "absent" against so many good names and important manufactures. This is all the more to be regretted as the French, as a rule, adhere to the use of the old sulphur match, and even in Paris it is difficult to procure either the amorphous phosphorus or paraffin matches with which we are so well supplied in England.

English match manufacturers seem to have done but little towards fulfilling another wish expressed by Dr. Hofmann with such earnestness in his report on the Exhibition of 1862, viz. "That before the Exhibition of 1872 shall have come round, *phosphorus* matches might be an obsolete appellation." Surely there are numberless cheap compounds that are ignitable by friction that might be used to supplant the objectionable phosphorus paste. We have almost abolished sulphur in the manufacture of matches in England; will no one endeavour to compel phosphorus to follow in its footsteps? It may be said that the amorphous phosphorus matches are free from the ordinary objections brought forward against the use of this element; but it must be remembered that the elimination of phosphorus from the lucifer-match manufacture would liberate for agricultural purposes a large amount of bones now consumed in its manufacture.

A few phosphates and hypophosphites are exhibited, but they do not call for special notice.

Glacial phosphoric acid is well exhibited by Messrs. Hopkin and Williams in large transparent masses. They also show cyanide of potassium in pure crystals. Their permanganate of potash and oxalate of cerium are also very good. The finest portion of their display is a large collection of nearly seventy different compounds of thallium. In addition to others already known, may be mentioned the vanadiate, the antimoniate, the sulphantimoniate, the permanganate, the tungstate, the thallio-chloride of platinum, and the sulpho-cyanide. Here again the deficiency of light greatly interferes with the examination of an exceedingly interesting collection, it being quite impossible to distinguish the crystalline forms of many of the most characteristic specimens. Baron Dumas rightly named thallium the ornithorhyncus of elements, uniting, as it seems to do, the heavy and light metals. In Messrs. Hopkin and Williams's series we find three salts that illustrate this fact in a singularly complete manner. We not only have thallium alum in unmistakable octahedral crystals, but also thallium Rochelle salt and thallium tartar-emetic. Professor Church, by acting on certain compounds of silver and potassium, under pressure, produced silver alum, thus connecting silver with the alkali metals. It would be interesting to know whether the link might not be still further strengthened by the formation of silver Rochelle salt and tartar-emetic. No doubt some of Mr. Crookes's opponents will seize on these three salts of thallium as proofs that it is an alkali metal, but the formation of the two silver salts just mentioned would form an additional reason for classifying this metal with silver, lead, and mercury. It seems a thousand pities that Messrs. Hopkin and Williams did not show this beautiful series in flat cups instead of in round jars, the former mode of exhibition being so much more convenient for the examination of crystals than the latter. A specimen of thallic alcohol, too, might have been added with advantage. Messrs. Hopkin and Williams deserve the greatest possible praise for showing that English manufacturers can be men of science as well, and they will, no doubt, feel rewarded by learning that their display has created a large amount of interest amongst both the English and foreign chemists who have visited the Exhibition.

In the same case Mr. Crookes exhibits an ingot of thallium of large size; also a tube containing the crystallised metal in hydrogen or in vacuo. The latter specimen was very beautiful at first, but, owing to some defect in the tube, the air appears to have entered and destroyed its brilliancy.

Amongst miscellaneous compounds Messrs. Foster and Gregory exhibit valerianate of zinc in beautiful crystals, also valerianate of iron and valerianate of amyl. Messrs. Savory and Moore contribute cobalticyanide of potassium, in fine yellow crystals. There is also a good specimen of sesquichloride of chromium in their case.

Dung-substitutes seem to have shared the fate of phosphorus and many other important products. Sulphate of copper is also absent.

Iodine and bromine are well represented by Messrs. Howards and Huskissons. Both firms show iodide and bromide of potassium of the first quality. The singular neutral iodide which forms semitransparent, yellowish, four-sided prisms, with pyramidal summits is exhibited in great perfection by the latter firm. These peculiar crystals, on examination, seem to be made up at their bases of aggregations of cubes, while the faces of the pyramidal summits are rounded off in a very curious manner. We do not remember to have seen any published account of these extraordinary crystals, which have been well known to several manufacturers for years; they are certainly deserving of attention from some of our leading crystallographers. The neutral iodide is used largely by photographers in the preparation of iodised collodion. Messrs. Huskissons have endeavoured to show every

crystallisable product in its natural crystals, and their case would afford much interesting material to the student of crystallography. Of course, a manufacturer is more likely to obtain perfect crystals than the chemist in the laboratory, who uses pounds and ounces where the other uses tons and hundredweights, and it seems a pity that other houses have not followed the good example of Messrs. Howards and Huskissons in exhibiting their salts in as high a state of crystalline perfection as possible.

Beginning with the elements, we find in Messrs. Huskissons' case a fine crystal of sulphur side by side with a number of nearly perfect rhombic plates of iodine, many of them two and a half inches long. The Rochelle salt crystals are also very beautiful, a remark that applies equally to those exhibited by Messrs. Howards. The bromide and iodide of cadmium are very fine, and the crystals of ammonio-sulphate of copper, hyposulphite of soda, phosphate of soda, sulphate of potash, bicarbonate of potash, and acetate of zinc, and many others, are really crystallographic studies. Messrs. Huskissons also show an extended series of iodides and bromides, but they are so crowded together in the utterly inadequate corner of space given to this house that it is quite impossible to examine them with the attention they deserve.

Messrs. Johnson and Matthey stand alone in exhibiting the salts of the noble metals. The first object that attracts the spectator is a splendid mass of crystals of nitrate of silver. The eye then wanders to a couple of large glass cups, filled with crystallised specimens of silicon and boron, of great size and beauty. After these come a very extensive series of salts of gold, platinum, rhodium, iridium, uranium, nickel, and cobalt. The uranium series is particularly complete, some of the double salts being of a very interesting character. Messrs. Johnson and Matthey also make a most magnificent display of platinum and its congeners, both in the rough and manufactured condition, in Class 40, but these we must leave until we turn our attention to that class.

In Messrs. Wilkinsons, Heywood and Co.'s case of very beautiful colours a specimen of what is called japanner's paste is exhibited, which shows how easily chemical knowledge applied in the right direction may effect a very valuable improvement. The makers of patent leather were formerly in the habit of boiling a mixture of oil and Prussian blue, in order to produce the singular black compound to which the beauty of their manufacture is due; but a little consideration on the part of Mr. Heywood led him to the conclusion that oxide of iron was the really active agent in the conversion of the oil. The experiment was tried and was found successful, and now japanners are supplied with oxide of iron specially prepared for the purpose at about one third the price they formerly paid for Prussian blue. Would that manufacturers would read and study Charles Lamb's delightful essay on roast pig, and learn the lesson it teaches—that it is not always necessary to burn down your expensively furnished mansion in order to procure the bilious enjoyment of feeding on roast pork.

LITERATURE.

BLOXAM'S CHEMISTRY.

Chemistry, Inorganic and Organic, with Experiments, and a comparison of equivalent and molecular formulæ. By CHARLES L. BLOXAM, Professor of Practical Chemistry in King's College, London. London: John Churchill and Sons, 1867, (pp. v and 676).

THIS work constitutes the third edition of Abel and Bloxam's 'Handbook;' but as Mr. Abel has not had leisure to devote to its preparation, Prof. Bloxam now undertakes the sole responsibility of authorship. The volume contains two treatises—one on inorganic chemistry (pp. 434), and a second on organic chemistry (pp. 200); it concludes with an excellent and very copious index.

It is probably a proposition to which the majority of reading men will assent, that the most interesting portion of the history of chemistry does not consist of its manuals. Lemery's treatise was certainly not very remarkable, unless for the few whimsical processes it described; Macquer's, which was once called "the text-book of Europe," contains scarcely a theory which will be culled with zeal by the moderns; and the great Thénard, whose valuable work has been copied by the usual servile herd of imitators, is scarcely even known in recent times as the author of a treatise for students. And these are only examples of what has prevailed almost universally. The historian of a science, indeed, never refers to a manual for the account of those great discoveries which have constituted its eras, or, perhaps, eras in the existence of mankind; he does not consult such an authority with respect either to any practical or theoretical advance which may have been made in that department of knowledge. Both he and the critic feel that a manual bears much the same relation to a special science that a contemporary play does to the social life of its time; it embodies but one aspect of its subject, and holds the mirror up to only a part of nature. We have now, therefore, simply to see whether Prof. Bloxam's book fairly represents the dogmatic chemistry of 1867.

In the inorganic part of the work the elements are classified into the prevalent divisions of metals and non-metals. The organic part is not arranged on any special principle. We had, indeed, hoped to find something new in the way of classification (a matter which is too much neglected by scientific writers), more especially as Naquet and Frankland have recently shown that the ordinary elemental classification is very unsatisfactory, and have endeavoured to improve it. Upon what legitimate grounds, for instance, ought osmium to be ranked as a metal, even if we must still retain the Berzelian distinction?

We regret to observe that Prof. Bloxam continues to adhere to the old notation and formulæ generally, as well as to English weights and measures and Fahrenheit thermometric degrees. The following

are the reasons whereby the author defends this procedure :

"In explaining chemical changes by equations, I have, as a general rule, employed symbols representing combining weights (or equivalents), and not atoms, of the elements. Had the work been intended for advanced students, I should have hesitated to incur the reproach of obstinate conservatism, or of being behind the chemical spirit of the time, though even then which of the more advanced systems was to be adopted would have been a very formidable question, for at present the different modes of representing chemical changes are almost as numerous as chemical writers." . . . . "In general, English weights and measures, and Fahrenheit thermometric degrees, have been employed, as conveying more clearly to the beginner the absolute values expressed, since the mental effort of converting what must still be called the Continental systems, slight though it be, might have the effect of diverting the attention of the reader from the chemical question under consideration." (Preface, p. iv.)

Now, with respect to notation, it is a well-known fact that the old system has nearly disappeared from modern British teaching. The defects and anomalies of the "old notation" were so numerous and glaring that it was impossible for any person who frequently used it not to be struck with them, and, in consequence of having been struck with them, to endeavour to get rid of them altogether. There were some who only lamented and hoped for better times; but the result was, as we all know, a protracted and very serious discussion of the entire subject. It is quite unnecessary, in this place, to detail the incidents of that discussion;—how the written language of chemistry, as it then existed, had the most advantageous defence; how the "new views" emerged with vigour from their hiding-places to a well-conducted attack; how, at one stage of the controversy, formulæ and types and symbols were supposed to have a something fixed and absolute about them, as certain of us still suppose. Suffice it to say that we obtained, as a result, a very general acceptance of the "new notation." Deficiencies, indeed, were still admitted; much yet remained to be done. But there was no doubt that a decided advance had been made; and it was agreed by an eminent and numerous majority that we had, in the new system, a compact and well-organised body of principles, a simplified and concordant notation, and formulæ which were supple enough to adjust themselves to the views of each individual theorist. Will it be credited that this last and indispensable qualification is the very one to which the author principally objects? As a matter of fact, however, a total omission of our present notation was impossible; and, accordingly, several comparisons are given of the old and new formulæ. The reader is thereby left to his choice; but, as we find medical students—and this is a severe test—very much prefer the modern method, we will not, on this occasion, discuss the expediency of relinquishing anything to the decision of a beginner.

With regard to English weights and measures and Fahrenheit degrees, we are also sorry not to be able to agree with Professor Bloxam. We cannot see why several manual-writers should exhibit so much tenderness in sparing their readers a little labour. Considering that the results of the greater part of the research done in this country are recorded in terms of the gramme, cubic centimètre, and Centigrade degrees; that one is unable to understand a foreign scientific paper without knowing something about these; and that they always give simpler numbers and facilitate calculation, it surely is conferring a favour to employ them in teaching. Why, indeed, should investigation be carried on in one language and its results be communicated in another?

One of the most important parts of a chemical manual is the definitions it contains; and it must be confessed that the definitions we meet with are, as a rule, not very remarkable for perspicuity or truth. How many authors ever give a single hour's thought to a definition? is a question which the discerning chemical public, or the puzzled student, may very justly propose. Yet who that is acquainted ever so little with the older chemistry will say that such venerable terms as "acid," "base," "salt," and "radicle," are to be defined off-hand, and that a study of their history is not essential to a proper knowledge of their meaning? Upon the question of acids both schools have, in our opinion, gone equally wrong. Theorists of the hydrogen school (if we may use such an expression) rely, in the main, on metallic displacements, which, to a certain extent, are quite favorable to their views. Why do they not go further, and, with our present knowledge of the action of sodium on ammonia, alcohol, and acetic ether, call the last three substances "acids"? Partisans of the "old" nomenclature and notation seem to us to have been usually as much at fault. They said, and very honestly supposed, that *their* acids reddened litmus, etc.; whereas, it appears, they never reddened litmus, etc. Pyrogallic "acid," in particular, caused them very much trouble and confusion. Neither side could perceive that "acid," as they themselves used the term, was the name of a function, and not the name of a substance. Hence the unsatisfactory and circular definitions we have all of us encountered. An acid is something which neutralises a base, thus forming a salt; a base is a body which neutralises an acid, and thus yields a salt; a salt is a substance which is produced by the action of a base on an acid. It is a series which has an end, but no beginning. And Professor Bloxam, we need hardly add, is very conservative on all these points.

It is with much greater pleasure that, putting general theory aside, we turn to the descriptive part of the section on inorganic chemistry. Oxygen is the first element described, and has received very excellent treatment at the author's hands. Its physical properties are first briefly mentioned, and its chemical behaviour is then very minutely detailed. There are no less than six illustrations of combustion in the gas, drawn with much truth and care; the explanations which accompany them give opportunities for the insertion of definitions, a historical remark, and hints respecting the properties of other elements. An account of several different methods of making oxygen

follows these, and we are subsequently presented with a succinct notice of ozone. Atmospheric air, its analysis and composition, are next described; and we then meet with hydrogen. The electrolysis of water and the decomposition of steam by induction-sparks are sufficiently alluded to, and are followed by an account of the action of water on metals. A classification of the metals is given on Thénard's principle. We have then as complete an account of the diffusion of gases as can be desired for the ordinary student. Many of the experiments which the author narrates are novel in form, if not in substance, and are accompanied with illustrative engravings. The chemical properties of hydrogen, the synthesis of water, the endiometric analysis of air, combining volumes and the oxyhydrogen blowpipe, constitute the succeeding topics. The remainder of the non-metals are discussed with at least an equal minuteness. In fact, Professor Bloxam has evidently thrown his main strength into this department of his subject. It is the domain of brilliant lecture experiments, of manipulative resources, of happy device—where, indeed, our author is perfectly at home. Those who have not the practical gift may safely consult this work for descriptions and illustrations of most of the experiments wherewith they need to accompany their lectures. The student who desires only an elementary knowledge of the science might have been perplexed as to what he should omit or peruse; a special provision, therefore, is made for him, by printing in small type what he does not require. At intervals there are reviews and summaries of previous statements, and these, we need hardly say, are invaluable to a beginner. They constitute, moreover, one of the new features in the book. A great deal of space has been gained for such purposes by incorporating titles with the paragraphs to which they belong, instead of using them as headings, and also by some praiseworthy omissions. We cannot but think that a further improvement is much to be desired—it would be advisable to work the whole of the notes into the body of the text. One cannot read very many paragraphs without being harassed with facts, hints, and surmises, at the foot of the page; and the reader is irresistibly reminded of mosquitoes, which these notes resemble, both in their intrinsic importance and the peculiar form of annoyance they produce. We really hope they will not make their appearance in any future edition. It is not without regret, also, that we have observed so much experimental physics in the first part of the work. Many writers on chemistry are gradually introducing so much information which pertains solely to the sister science, that we must really appeal to them to remember that the word *chemistry* has a meaning of its own. Or else, it will be well to enlarge the definition of that very misused term, and to include within its study (upon justly equal grounds) the theory of atmolysis and the movement of the joints.

The chemistry of the metals abounds with descriptions of processes, and is very sound and complete. Professor Bloxam has been very industrious in collecting his facts, and minutely accurate in recording them. Every one who peruses this part of the book will feel that the author is anxious to give him full information, with as few mistakes as possible, and within a moderate compass of expression. The rarer metals are very properly dismissed with a few words; indeed, we should have preferred the entire exclusion of some. It is impossible to compress any information worth the having on such subjects as the cerium-group or the entire platinum-group within the limits of an elementary treatise. The chapter on iron, which is principally occupied with the chemistry of the various iron manufactures, is a very good and satisfactory specimen of this part of the work, and includes an excellent description of the Bessemer process. Copper, also, is equally well treated; an account of its metallurgy, the mode of assaying it, the impurities which occasionally affect its qualities, the action of sea-water upon it, etc., are all given in an extremely direct and intelligible exposition. The inorganic part concludes with some very valuable special chapters on such topics as glass, pottery, and porcelain; that on gunpowder possesses an original value, and has, therefore, an enhanced importance.

The section relating to organic chemistry, which constitutes the smaller division of the entire work, is one of the novelties in this edition. Its general plan is that of a series of chapters, of varying length, referring to such subjects as "Products of the Destructive Distillation of Coal," "Oil of Bitter Almonds and its Derivatives," "Starch," "Gun-cotton," "The Alcohols and their Derivatives," "Organic Alkaloïds," "Oils and Fats," "Animal Chemistry," and "Nutrition of Animals." Under some of these suggestive titles the reader will find the ordinary manufacturing processes described with great clearness and abundance of illustrative equations. One of the most important, the comparatively recent manufacture of gun-cotton, is discussed at very considerable length; the mode of preparation, the chemical composition, the products and effects of explosion, are given fully from the best and most modern data. Some of the results of Frankland and Duppa's researches are mentioned in their appropriate place, and there is a short account of agricultural chemistry.

The excellences and demerits of the organic, correspond closely with those of the inorganic part. It is always with a practical end that the author writes. On a theoretical point he not unfrequently leaves the reader quite in a state of indecision as to which of certain views he shall adopt. This is especially the case with the theory of etherification, where, we will venture to say, that no student will know whether to accept the doctrine of contact-action, or that of alternate transformation (Williamson's theory); and he will be very much puzzled to decide between the proper values of the rational formulæ—

$$C_2H_5.HO \text{ and } C_2H_4.H_2O$$

for common alcohol. The table of organic alkaloïds, too, requires emendation and extension.

The general character of this book will be sufficiently evident from the account we have given of it. Those who are familiar with the intentions and dispositions of students are well aware of the fact

that not one in a thousand desires to learn chemistry as a profession. As a rule, therefore, what the beginner considers most serviceable to him (and what, indeed, is most usually advantageous) is a body of sound instruction, direct and intelligible in its tone, and not overburdened with theoretical disquisition. In addition to this class there is a large number of outsiders, who are not students, and who (especially in England) are desirous of having accurate general information merely on the *facts* of our science. Both parties will find that in Mr. Bloxam's book most of their wants have been admirably provided for. He has not, in our opinion, adopted the best and simplest course with regard to formulæ and kindred questions. From his theoretical views, taken as a whole, we must express our hearty dissent. It is only the practical side of the dogmatic chemistry of our time that has been represented. But that has been done admirably and with a great expenditure of time and trouble. Most lecturers will find here some experimental contrivance of value, conspicuous for being neat, clever, and inexpensive, while students and beginners generally are offered a large but not unmanageable stock of accurate information, the possession of which will render most of the processes of manufacture and most of the common phenomena of daily life sufficiently explicable and clear. Professor Bloxam's 'Chemistry' ought, therefore, deservedly to rank high as an aid to the proper acquirement of a general education.

MEDICAL STUDENTS.

Medical Students of the Period. By R. Temple Wright, M.D. Edinburgh and London: Wm. Blackwood and Sons.

The author of this little volume appears to be one of those who think the title of a book need not of necessity describe the contents of it. The volume before us has very little to do with medical students "of the period" as men and members of society, but almost exclusively treats of what they have to accomplish in the way of study. Here and there, however, the author endeavours to say a few words in defence of the much-maligned medical student, whose good name, says Dr. Wright, has been much damaged by such unscrupulous individuals as the defendants at the police courts, who, preliminary to paying a fine of five shillings or upwards for their escapades of the previous evening, "have wit enough left to call themselves medical students." The medical student "of the period" is, according to Dr. Wright, a totally different person from the police court brawler. He rises betimes, attends his early morning lectures with unvarying punctuality, works assiduously at his studies, till at the end of his probationary career he undergoes the ordeal of examination, through which, as a matter of course, he passes with facility and distinction. As a readable, untechnical description of the course of study necessary to produce an M.D. or an M.R.C.S. the volume is commendable enough, but we must take exception to the light and flippant style which the author often adopts when speaking of scientific subjects.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

Experiments on the Absorption of Heat: Influence of Vapour Adhesion. By G. Magnus.*

In the year 1861 researches were undertaken, quite independently, by Prof. Tyndall and myself on the transmission of heat through different gases. Our results agreed perfectly in this respect—that gases vary very much in their power of transmitting heat; in fact, that some of them, enclosed in a tube one meter long, transmit less than half the heat which is made to impinge upon them, whereas atmospheric air, under similar circumstances, scarcely affects the transmission. But with reference to air which has been saturated with watery vapour, our experiments exhibited a complete discrepancy. Prof. Tyndall found that perfectly moist air absorbs an extraordinary amount of heat; that, indeed, as he expresses it,† a single atom of vapour of water absorbs 16,000 times as much as an atom of either oxygen or nitrogen. On a second occasion he stated that such air, contained in a tube four feet long, absorbs 4·2 to 6 per cent. of the heat which reaches it. I observed, on the contrary, that there was no clear difference between the absorbing power of thoroughly moist and perfectly dry air at the temperature of the room. Prof. Tyndall has drawn important meteorological inferences from his results, in which he has been followed by other physicists. These inferences, valuable and interesting as they are, still leave it open to inquire what is the actual fact with regard to the vapour of water; and to account for the inadvertence which has caused an essential difference between myself and so scrupulously accurate an experimenter as Prof. Tyndall.

At the commencement of the year 1866 I published‡ a memoir on the influence of the absorption of heat on the formation of dew, and it was shown that so long as atmospheric watery vapour is perfectly transparent—in fact, so long as it is a true vapour—there is no observable difference in radiating power between dry air and that which is saturated with moisture, but that a distinction is perceptible both with regard to radiation and absorption when the vapour assumes the properties of mist. Prof. Tyndall immediately replied,§ maintaining his previous statement, and shortly afterwards a third physicist appeared as umpire between us. Prof. Wild, of Berne, made a number of experiments after the method of Tyndall, and established‖ the conclusions which Tyndall had announced. Any one who reads Prof. Wild's memoir will be strongly impressed with the experimental accuracy of its author. Such, indeed, was my own feeling. But my results had been carefully obtained, and were not the consequence of any

* 'Pogg. Ann.,' cxxx, 207.
† 'Phil. Mag.,' xxv, 203.
‡ 'Pogg. Ann.,' cxxvii, 613.
‖ 'Phil. Mag.,' xxxii, 118.
§ 'Pogg. Ann.,' cxxix, 57.

preconceived opinion; I therefore decided on performing a fresh investigation, which was fortunately all the more easy, as Prof. Wild had left on record the precise dimensions of his apparatus. I constructed the apparatus in the following manner:—A brass tube 60 cm. long and 6 cm. in diameter, polished both inside and outside, was fixed on either side of a thermopile, to which the cones had been attached; the axes of the two tubes and that of the thermopile were in one and the same straight line. In the prolongation of this line and directly facing it there was placed in front of each tube a blackened tin cube, in which water was kept boiling by means of a lamp. These cubes, which served as sources of heat, stood each at the distance of 10 cm. from the end of its tube, and the other ends of the tubes were equally removed from the cones of the thermopile. A screen, movable by means of a screw, was adjusted between one of these tubes and the adjacent cube, and in this manner such a portion of the rays from this tube could be intercepted that the radiation and heating effect on the pile was always the same on either side, and the attached galvanometer exhibited no disturbance. Each of the brass tubes had a lateral aperture 15 cm. from each end, for the introduction and removal of air; and the aperture nearest to the thermo-circuit was connected by caoutchouc to two tubes, one of which contained pumice-stone soaked in sulphuric acid, while the other contained pumice-stone saturated with water. These tubes were connected at their other extremities with a caoutchouc compression pump, such as is commonly used for blowpipe purposes. Dry air, therefore, entered one of the tubes and moist air reached the other. In order to secure the effusion of this air into the tubes, and to prevent its escape at the proximate open ends, both of the other side openings were connected with an air-pump. Subsequently Prof. Wild preferred to place the lateral apertures which were distant from the pile in communication with the compression pump, and the other two in connection with the exhausting pump.

Instead of the caoutchouc force-pump I have employed a somewhat larger double bellows; and instead of pumice, pieces of glass, soaked in water, were used; in other respects my apparatus was quite similar to the foregoing. Also, unless otherwise stated, the air was blown in at the more distant aperture. I thus obtained the same results as Prof. Wild, viz. heating of the pile when dry air was blown in, and cooling when moist air entered; only the excursions of the galvanometer were somewhat larger than he states, doubtless owing to the superior sensitiveness of my instrument.

It was not long, however, before the real source of the circumstances which led to this discussion became apparent. I had found in one experiment that if one of the tubes were blackened in the inside, and the apparatus were so adjusted that equal quantities of heat reached the pile on either hand, the heating action of dry air and the cooling effect of moist air were very marked in the tube which remained internally polished, whereas the action was much less considerable in the blackened tube. When the screen was removed and the corresponding cube placed at the proper distance to produce the same heating effect as before, the effect was, as might have been expected, exactly the same. The cooling action in the polished tube was to that which was observed in the blackened tube approximately as 3·75 : 1·4 per cent. Turned iron tubes gave the same results as brass ones, and the character of the phenomena was unchanged when white-hot platinum discs were substituted for the cubes containing boiling water. The inference is that the surface of the tube plays an essential part in these experiments. This inference was amply confirmed by using cotton velvet, pasteboard, coarse paper, and tinfoil, for the lampblack employed previously.

I had formerly noticed* that solid bodies, metallic or otherwise, attract watery vapour from the air, and condense it on their surfaces. These condensed vapours cannot, indeed, be perceived by the eye; but the heat which is produced when moist air impinges on a solid having the same temperature, and the cold of dry air, admit of no other explanation. Such a condensation must have taken place when moist air was passed through the tubes already referred to; and it is obvious that on this circumstance the effects abserved by Profs. Tyndall and Wild in reality depend.

It may be shown in the folowing manner that the tubes become covered with water throughout their entire length. A linear thermopile is placed upon them in any part, care being taken to keep the line of contact parallel with the axis of the tube. Every time moist air is introduced the pile becomes heated; every time time dry air enters cooling takes place. Now, if we reflect how much more heat is absorbed by water than by a polished metallic surface, it becomes apparent that the inside of the tube must absorb a much greater proportion of the incident rays when moistened with water than when it is thoroughly dry. But the more heat the tube absorbs the less does it reflect, and the less reaches the pile. And the water, under these circumstances probably acts all the more powerfully, inasmuch as it does not form a continuous layer, but is deposited in isolated particles, which scatter in all directions the scanty residue which escapes absorption. Lampblack acts in the same way as water which has thus been deposited, only to a greater extent; hence its absorption was increased but little, or not at all, by the water which separated. Accordingly, when moist air was driven through a tube which had been thickly coated with lampblack, or lined with velvet (whether a source of heat was employed or otherwise), no cooling ensued; but, on the contrary, a heating effect. The last result can but seldom obtain in the case of polished metallic tubes, because the heat evolved is immediately diffused through the mass of the metal, and this is prevented by a lining of lampblack or velvet.

The influence of a varied temperature was next examined. One of the tin tubes was surrounded with a wider concentric tube, through which water could be transmitted; the width of the annulus was 18 mm.

* Ibid., cxxi, 174.

When the tube was only a few degrees colder than the moist air which entered it the depression of temperature, as indicated by the galvanometer, was so great that the needle went beyond its scale. More time was required for this extreme effect to be obtained than when both the air and the tube had the same temperature, for the obvious reason that the deposition of an increased quantity of water rendered a greater supply of warm air necessary. When the tube was made hotter than the air-supply, such an action as Prof. Wild has indicated took place, but this was slighter as the heat was raised. Yet, even when the tube was at 38°, and the air which I introduced was at 16°—17°, moist air caused a perceptible diminution, and a subsequent current of dry air an obvious elevation, of temperature. Another experiment convinced me that water is actually thus separable from air, even when the latter is 22° above its dew-point, and on a surface which has precisely the same temperature as the heated air itself. Air saturated with moisture at 16° was heated to 38° and driven against the open side of a pile whose temperature was kept constantly at 38°. The pile gave proof of a heating effect when the moist air reached it, but showed a depression when the air was dry, and such was the case whether lampblack did or did not intervene.

It is easy to show that, in these experiments, only reflected heat reaches the pile. If a plane or concave mirror be employed, and dry or moist air be directed against it, it will be found that there is no diffeience in calorific action on the pile. This is due to the fact that the heat undergoes but one reflection at the surface of a mirror, whereas, within a tube, it is so frequently reflected that its course is almost spiral. If the temperature of the mirror be depressed but little below that of the air which is blown against it, a very marked cooling effect is produced by moist air. But it is then always easy to see that a quantity of water has been precipitated.

Alcohol behaves in a very similar manner to water, only with much greater energy. But the vapours of alcohol are capable, in addition, of absorbing rays of heat, as is shown by the following experiment. Four narrow brass tubes, of 8 mm. in diameter and 66 cm. long, were placed horizontally at a distance of 12 mm. apart; each of them was pierced with forty small holes, 12 mm. from one another; one end of these tubes was closed; at the other extremity all four were connected by a transverse tube which communicated with a bellows. As the small holes of these tubes were all turned uppermost, a number of narrow vertical currents of air could be obtained on using the bellows. This system of tubes was substituted for one of the brass ones, and so disposed between the pile and a cube that the heat rays could only reach the pile by traversing the vertical currents. When the air which was introduced had been saturated with alcohol vapour, a decided cooling took place; when it was free from the vapour the pile reassumed its previous temperature. Now, in this case there was no reflection; consequently, the cooling of the pile could only have been due to an absorption of heat by the alcoholic vapour.

Water behaves in a very different manner. When either dry air or air thoroughly saturated with moisture is directed through this system of tubes, no alteration in the heat of the pile could be perceived. I have repeated this experiment very frequently, but always with the same result. Hence I think I have fully established the accuracy of my previous statement, that there is no decided distinction between the absorbing power of moist and dry air. I believe that the true source of the difference between Prof. Tyndall and myself is to be traced to the hitherto unrecognised alteration which the vapours of water, invisible to the eye and condensed on the sides of the tube, induce in the character of the reflection of heat rays. It is thus intelligible why that physicist and Prof. Wild have attributed the powerful cooling of the pile, observable when moist air is introduced, to a corresponding absorption by the vapour of water. But I am convinced that both of them, on repeating these experiments with thickly blackened tubes, or tubes lined with velvet, will share in the belief that aqueous vapour has no very great power of thermic absorption.

On the Isomeric States of Silicic Acid. By E. Frémy.*

Among the numerous allotropic varieties of silica there are two which are distinguished from one another by very marked characters, viz. quartz, which is insoluble in dilute alkalies, and has a sp. gr. of 2·6, and the silica obtained by decomposing silicic fluoride with water and calcining the hydrate, which dissolves in alkaline liquids, and has a sp. gr. of only 2·2. These two varieties have been shown by Ch. Sainte-Claire Deville and H. Rose to differ in many of their chemical properties, and Frémy concludes, from the experiments described in the present communication, that they are further distinguished by different equivalent values or degrees of basicity; he designates the silica of quartz as silicic acid, and that obtained from silicic fluoride as metasilicic acid.†

The compounds of metasilicic acid with alkaline bases differ considerably from those produced by quartz. The alkaline metasilicates are soluble in water, gummy and uncrystallisable, and to obtain them in the solid state they must be precipitated by alcohol. At a red heat they give off water, the loss of which, as in the alkaline metastannates, is attended with partial separation of the acid and base. An alkaline metasilicate treated with an acid yields a hydrate, from which, by calcination, an anhydrous silicic acid is obtained, having the same composition as quartz, but retaining its solubility in dilute alkaline leys, even after prolonged calcination.

Metasilicic acid is triatomic; its hydrate is represented by the formula $(SiO_3)_3.3HO$,‡ and in

* 'Comptes rendus,' lxiv, 243 (11 Février, 1867).

† Frémy's metasilicates are doubtless identical with Graham's *colli-silicates* or *co-silicates* ('Chem. Soc. Journ.,' xv, 246).

‡ Si=21; O=8. According to the formula SiO_2 [Si=28; O=16], now generally adopted, Frémy's silicic acid would be represented by the formula $(SiO_2)_3.6H_2O$, and his metasilicic acid by $(SiO_2)_9.6H_2O$.

presence of bases, exchanges successively its three atoms of water for an equivalent quantity of base, so as to form the metasilicates* $(SiO_3)_3.MO.2HO$; $(SiO_3)_3.2MO.HO$; and $(SiO_3)_3.3MO$.

Silicic acid differs from metasilicic acid in its properties, its equivalent, and the nature of its salts. It is triatomic, forming the three series of salts, $SiO_3.MO.2HO$; $SiO_3.2MO.HO$; $SiO_3.3MO$; which combine among themselves to form salts of intermediate composition.

The alkaline silicates and metasilicates also contain water of crystallisation, which, however, does not appear to play the part of a base in the salt-molecule.

The alkaline, and especially the sodic silicates, differ from the metasilicates by their tendency to crystallisation. When heated they do not lose their solubility like the metasilicates. When treated with acids, they yield a hydrate which might be confounded with that of metasilicic acid, only that when heated to redness, it yields anhydrous silica insoluble in alkalies.

It appears, then, that both the silicates and the metasilicates retain the generic characters of the particular modification of silicic acid which enters into their composition.

On the Chlorine- and Oxygen-compounds of Niobium and Tantalum. By H. Deville *and* L. Troost.†

The recent researches of Marignac‡ have shown that there is but one oxide of niobium, Nb_2O_5§, identical with Rose's hyponiobic acid (to which he assigned the formula Nb_2O_3); also that Rose's niobic chloride has the composition $NbCl_5$, and that his hyponiobic chloride (formulated as $NbCl_3$) is really an oxychloride, having the composition $NbOCl_3$.

MM. Deville and Troost, in a former memoir,‖ corroborated these results by determining the vapour-density of these two chlorine compounds (V.-D. of $NbOCl_3$, obs. $= 7{\cdot}9$; calc. $= 7{\cdot}5$; that of $NbCl_5$, obs. $= 9{\cdot}6$; calc. $= 9{\cdot}4$); and they have now succeeded in producing the oxychloride synthetically by passing the vapour of niobic chloride several times over ignited niobic oxide:

$$Nb_2O_5 + 3NbCl_5 = 5NbOCl_3.$$

Tantalum, on the other hand, does not form an oxychloride. The pure chloride, $TaCl_5$ [Ta = 182], may be passed any number of times over ignited tantalic oxide without experiencing the slightest alteration.

Tantalic chloride is a crystallisable solid, melting at 211·3°, and boiling at 241·6°, under a pressure of 753 mm. It has a pale yellow colour, and alters rapidly in the air, giving off scarcely visible fumes of chlorhydric acid, and becoming coated with tantalic oxide. Its vapour-density, taken at 360° (in vapour of mercury), is 12·8; by calculation 12·5. It gave, by analysis, 51·25 p.c. tantalum and 48·75 chlorine; calc. 50·62 tantalum and 49·38 chlorine.

Niobic chloride, $NbCl_5$, melts at 194°, and boils at 240°.

* Not to be confounded with the salts called metasilicates by Odling ('Phil. Mag.' [4], xviii, 168).
† 'Comptes rendus,' lxiv, 294 (18 Février, 1867).
‡ 'Comptes rendus,' lx, 234 1355.
§ Nb = 94; O = 16.
‖ 'Comptes rendus,' lx, 1221.

On Derivatives of Cumol. By Schaper.*

Several of the derivatives of cumol have been examined by this chemist. Nitro-cumol crystallises in long, yellow needles, whose fusion-point is 71°, and which distil at 265° without decomposition. Cumidin was obtained from the nitro-compound by Roussin's process. It crystallises from water and alcohol in long silky needles, and fuses at 62°. The hydrochlorate forms prisms. When nitro-cumol is treated with chromic acid, it furnishes paranitroxylylic acid, a substance which is readily soluble in alcohol and boiling water, but difficultly soluble in cold water—its fusion-point is 195°. Its barium salt contains nine, and its calcium salt six proportions of water; the ethyl salt is remarkable for melting at the temperature of the hand. The author finds that the oxidation of cumol gives rise to the formation of xylylic acid.

* 'Zeitschr. Chem.,' x (Jan., 1867).

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

Publications Received.—'Bulletin de l'Académie Royale de Belgique,' xxiii, 1, 2, 3. 'Le Moniteur Scientifique,' 247, 248.

Book Received.—'Chemical Notes for the Lecture Room.' By Dr. Wood, F.C.S.

MEETINGS FOR THE FORTHCOMING WEEK.

May.

Monday, 6. Royal Institution.
General Monthly Meeting. 2 p.m.

Tuesday, 7. Royal Institution.
Prof. Blackie, *On Plato*. 3 p.m.
Civil Engineers. 8 p.m.
Geologists' Association. 8 p.m.

Wednesday, 8. Society of Arts. 8 p.m.
Geological Society. 8 p.m.
Microscopical Society. 8 p.m.

Thursday, 9. Royal Institution.
Prof. Huxley, *On Ethnology*. 3 p.m.
Royal Society. 8.30 p.m.
Royal Society Club. 6 p.m.

Friday, 10. Royal Institution.
Prof. Bain, *Correlation of Force in its bearing on Mind*. 8 p.m.
Astronomical Society. 8 p.m.

Saturday, 11. Royal Institution.
Prof. Huxley, *On Ethnology*. 3 p.m.

MAIN SERVICE FILTER.

This Filter, which is shown in section, consists of an external metal case, formed in two parts, *a* and *b*, fastened together by nuts and screws, I, I. The water to be filtered enters by the pipe F, passes first through the coarser filtering media A, then through the finer filter B, and flows off pure through the exit pipe C. By this means all the coarser impurities of the water are arrested by A, and consequently do not interfere with the action of B. These impurities accumulate in the cavity K, from whence they may be readily removed from time to time as may be requisite, by allowing the water to pass into the filter through M. This is instantly done by turning the three-way cock H, closing the exit tap C, and unscrewing the tap D; when the water entering the upper cavity by the pipe E will be forced in the reverse direction, through the coarser filtering media A, and carry off all impurities which that filter has been the means of arresting. This operation does not occupy more than a few seconds of time. These Filters are used by the Metropolitan Free Drinking Fountains Association, the General Post Office, London Hospital, Swansea Prison, and other large establishments.

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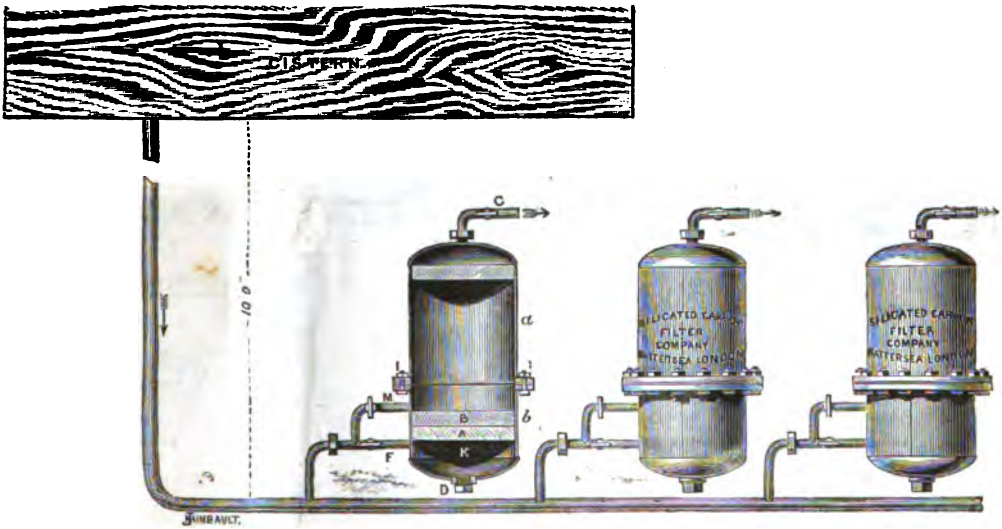

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Organic matter contained in an Imperial Gallon	3·8 gr.	0·6 gr.

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THE LABORATORY:

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CONTENTS.

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⁎ All Communications relating to the Editorial Department should be addressed to THE EDITOR, 4, Norman Terrace, Stockwell, London, S.; but all letters relating to Advertisements, Subscriptions, and General Business Arrangements, to the Publisher, JAMES FIRTH, 42a, Cannon Street, London, E.C.

ORIGINAL COMMUNICATIONS.

ON ALLOYS.*

By A. MATTHIESSEN, *F.R.S., Lecturer on Chemistry at St. Mary's Hospital Medical School, and* C. HOCKIN, *M.A., Fellow of St. John's, Cambridge.*

II. *On the Determination of the Coefficients of Expansion caused by Heat.*

UNDER this head the methods of determining the linear and cubical expansion caused by heat will be discussed; but as the cubical expansion may be taken as three times the linear, if the latter is determined, the cubical may easily be deduced; for if the linear expansion of a body is expressed by the formula—

$$L_t = L_0 (1 + at),$$

where L_t represents its length at t° C., L_0 its length at 0° C., and $\acute{a}$ its increment in length for 1°, then—

$$L_t^3 = L_0^3 (1 + at)^3 = L_0^3 + 3L_0^3 at + 3L_0^3 a^2 t^2 + L_0^3 a^3 t^3$$

will represent its cubical expansion at t°. But as a is very small, the terms $3L^3a^2t^2$ and La^3t^3 become so immeasurably small that they may be neglected, and the formula may be written—

$$L_t^3 = L_0^3 + 3L_0^3 at = L_0^3 (1 + 3at);$$

or, taking $V = L^3$—

$$V_t = V_0 (1 + 3at).$$

The linear expansion of metals or alloys can only be determined directly with accuracy when they can be obtained in bars of considerable length, say one or two mètres. The method generally used for such determinations is as follows:—One end of the bar is rigidly fixed, so that the linear expansion can only take place in one direction. Placed at and touching the other end of the rod or bar is a micrometric screw, with which the increment of length is measured. A simple apparatus of this description, which yields correct results, is the following:

In the long zinc trough, A (fig. 1), the rod is placed, the ends of it first passing through holes in the ends of the trough; into these openings are soldered pieces of zinc-tubing (fig. 2, *a*, *a*) of about 50 mm. long, so as to serve both as a rest for the rod passing through them and as a means of making the trough water-tight. As the greater part of the zinc tubing projects inwards, it is easy to draw a piece of vulcanised india-rubber tube over its end, and on passing the rod through this the trough becomes water-tight. The few millimètres of the zinc tube projecting outwards serve to keep the ends of the rod (about 5—10 mm.), if not quite at the same temperature as the bath, at all events, very nearly so. Three other rests are placed in the bath to support the rod (fig. 2, *b*, *b*, *b*). The length, width, and height of the bath may be 1800, 180, and 150 mm. (measured inside). The long sides and cover should be made double. Through an opening in the cover the thermometer T is fixed, the bulb being in the water at the level of the rod; a smaller one (T') is placed near the larger one, so as to give the mean temperature of the column of mercury not immersed in the water, that is, its bulb is placed near the middle of the exposed column.

Fig. 2.

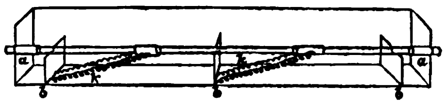
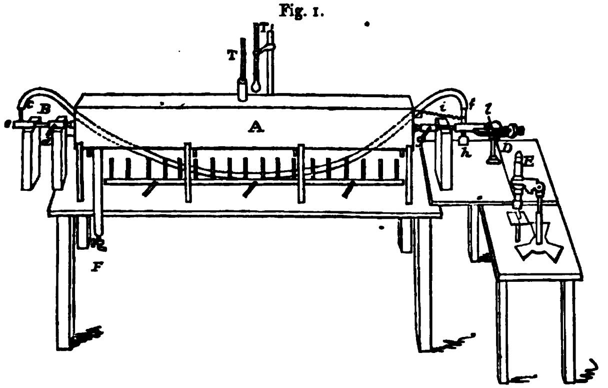


Fig. 1.

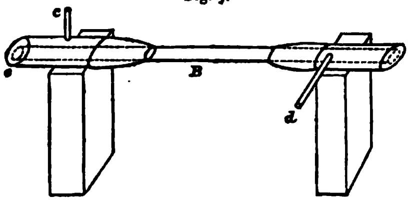


To give the necessary firmness to the apparatus, and to cause the expansion of the rod to be indicated in only one direction, the following arrangement is made:—A hole is made in the wall of the room, so as to take the end *e* of the tube B (fig. 1). Fig. 3 shows the construction of this part of the apparatus. It consists of a stout glass-tube fitted into zinc caps, the ends of the tube touching the ends of the cap, so that when water enters at *d* it is forced to flow to the end of the zinc cap to enter the tube, and to make its exit in the same manner at the other end. The

* Continued from page 19.

zinc is connected with the glass by rubber tubing; the tube B, the end of which is cemented to the wall, is supported by two bricks, to which it is also cemented, thereby forming a solid resistance for the one end

Fig. 3.

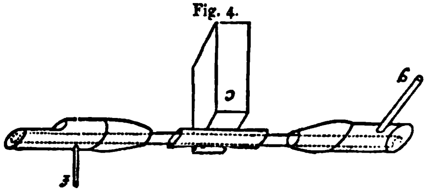


of the rod to rest against. The communication between the other end of the rod and the measuring apparatus is similarly constructed (fig. 4); the length of the fixed glass-tube B being about 300, and of the movable one 350 mm. To steady the latter as much as possible the tube passes through a somewhat larger one cemented to the brick, as shown in fig. 4. This allows the tube to move backwards and forwards with ease without otherwise altering its position. It is kept pressing on the end of the rod by the spring *i* (ordinary bell-spring), a weight (*h*) hanging below it to counteract the upward pulling of the spring. Similar springs (Fig. 2, *k*, *k*) fixed to the bar in the trough keep it pressed against the end of the fixed glass tube.

The whole of the apparatus should be arranged on a foundation where no vibration can possibly affect it, as the slightest movement in any part of the apparatus will vitiate the results.

A convenient form for the micrometric apparatus is a screw, to the one end of which a piece of brass is fixed, through which passes a movable

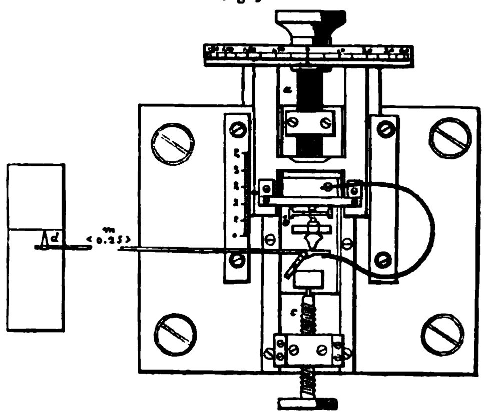
Fig. 4.



circular piece of the same alloy, faced with agate. On turning the screw this piece of brass, as soon as it touches the end of the zinc cap, presses against the short arm of the lever L, and thus indicates the point of contact. The best method to obtain accurate readings is to turn the screw until the bent end of the long arm of the lever covers the line on the table beneath it, and to avoid parallax the point should be observed through a tube (E) having a fine opening at the top and a magnifying-glass at the bottom. With such an arrangement the length increment can be determined with greater accuracy—in fact, easily to 0·001 mm., when the length turn of a thread of the screw is about 0·2 mm., and the milled head is divided into 200 parts.

A convenient method of calibrating the screw is to have a coarse one (*c*) fixed opposite to it, as shown in fig. 5. If pieces from the ends of a wire be bent at right angles to the axis of the wire and to each other, and placed on the small support (*b*), its diameter may be determined at any point of the screw by turning the auxiliary screw either backward or forward as required; by this means comparative length values for each thread of the screw may be obtained. To

Fig. 5.



determine the absolute length value of the turns of the screw, it is necessary to make some comparisons between them and those of some standard screw, or to deduce it by measuring a piece of some substance, the dimensions of which are accurately known, or, in default of these, the following process may be adopted. It is based on the fact that, when the specific gravity, length, and weight of a wire are given, the diameter may be deduced, for—

$$W = r^2 l s \pi;$$

$$\text{therefore } r^2 = \frac{W}{l s \pi},$$

$$\text{or } D = 2\sqrt{\frac{W}{l s \pi}},$$

where W, *l*, *s*, *r*, D, represent the weight, length, specific gravity, radius and diameter of

the wire, and π the ratio of the circumference of a circle to its diameter, $\pi = 3·1416$, Log $\pi = 0·4971499$,

For the determinations of the above values, it is as well to take a length of wire of about two mètres, otherwise, when taking the specific gravity the loss of weight in water would be too small for any great accuracy. One point in favour of the method is that the square root of all the determinations enters into the calculations. To test the accuracy of this method, a hard-drawn silver wire, of 2138 millimètres length and 7·0189 grms. weight, was used. Its specific gravity was found equal to 10·455, hence its diameter would be 0·632. The ends of the wire, having been cut off and measured with a micrometer screw, as just described, were found equal to 3 whole turns and 83 divisions, or, as the milled head was divided into 200 divisions, the diameter of the wire will be equal to 683 divisions, and these will correspond to 0·632 millimètres. One division will, therefore, be equal to 0·000927 millimètres, or the length value of a thread of the screw equal to $200 \times 0·000927$, which is 0·185 millimètres.

The length of a thread of the same screw as compared with the normal screw-apparatus at Kew, through the kindness of Mr. Balfour Stewart, was found equal to 0·185 millimètres.

The value found by measuring pieces of wire which had been measured with a corrected micrometric apparatus attached to a microscope was 0·184 millimètres. When making careful determinations it is of course necessary that all parts of the apparatus should be carefully tested, and it may be as well to say here a few words regarding thermometers. The zero or the boiling-points, or, better still, both, should be from time to time re-determined, owing to the liability of their displacement, and if the thermometers are not made by some very competent person, they ought to be carefully compared with some standard thermometer. A correction must be made for that part of the column of mercury not immersed in the water, and this may be done by using the formula—

$$\text{correction} = N(T - t) \times 0·0001545,$$

where N is equal to the number of degrees exposed, T the uncorrected temperature of the water, and t the temperature of the thermometer, the bulb of which is placed in contact with the stem of the other thermometer half way between the top of the mercury column and the middle of the cork. The number given is the apparent expansion of Mercury in the glass. The accompanying table (Kopp's) gives the corrections (Watts' 'Dict. of Chem.,' III, 86) to be added to the observed readings of the thermometer.

T — t	N 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	170.	180.	190.	200.
10.	0·02	0·03	0·05	0·06	0·08	0·09	0·11	0·12	0·14	0·15	0·17	0·18	0·20	0·22	0·23	0·25	0·26	0·28	0·29	0·31
20.	·03	·06	·09	·12	·15	·18	·22	·25	·28	·31	·34	·37	·40	·43	·46	·49	·52	·56	·59	·62
30.	·05	·09	·14	·18	·23	·28	·33	·37	·42	·46	·51	·55	·60	·65	·70	·74	·79	·83	·88	·92
40.	·06	·12	·18	·25	·31	·37	·43	·50	·56	·62	·68	·74	·80	·86	·93	·99	1·05	1·11	1·17	1·23
50.	·08	·15	·23	·31	·38	·46	·53	·62	·70	·77	·85	·92	1·00	1·08	1·16	1·23	1·31	1·39	1·46	1·54
60.	·09	·18	·28	·37	·46	·56	·65	·74	·83	·93	1·01	1·11	1·20	1·29	1·39	1·48	1·57	1·66	1·76	1·85
70.	·11	·22	·33	·43	·53	·65	·76	·87	·97	1·08	1·19	1·29	1·40	1·51	1·62	1·72	1·83	1·94	2·05	2·16
80.	·12	·25	·37	·50	·62	·74	·87	·99	1·11	1·23	1·36	1·48	1·60	1·72	1·85	1·97	2·09	2·22	2·34	2·46
90.	·14	·28	·42	·56	·70	·83	·97	1·11	1·25	1·39	1·52	1·66	1·80	1·94	2·08	2·22	2·36	2·49	2·63	2·77
100.	·15	·31	·46	·62	·77	·93	1·08	1·23	1·39	1·54	1·69	1·85	2·00	2·16	2·31	2·46	2·62	2·77	2·93	3·08
110.	·17	·34	·51	·68	·85	1·01	1·19	1·36	1·52	1·69	1·86	2·03	2·20	2·37	2·54	2·71	2·88	3·05	3·22	3·39
120.	·18	·37	·55	·74	·92	1·11	1·29	1·48	1·66	1·85	2·03	2·22	2·40	2·59	2·77	2·96	3·14	3·33	3·51	3·70

T_1	T_2	T_3	T_4	a	b	c	$\frac{a}{T_2 - T_1}$	$\frac{b}{T_3 - T_1}$	$\frac{c}{T_3 - T_4}$
7°·4	—	99°·9	7°·4	—	2·807	2·803	—	0·03034	0·03017
7·0	50°·7	100·1	10·4	12·63	2·808	2·718	0·02890	0·03016	0·03030
8·4	51·2	100·3	7·0	12·52	2·807	2·830	0·02925	0·03054	0·03033
7·5	51·9	100·3	7·8	12·95	2·805	2·803	0·02917	0·03023	0·03030
8·6	50·9	100·6	7·2	12·38	2·775	2·812	0·02927	0·03016	0·03011
					Mean . . .		0·02915	0·03026	

As an example of the method the following results may be quoted, which were obtained with a certain copper rod. The different parts of the apparatus having been put together, the trough was filled with water by connecting the tap F with the water tap, and when full the water was still allowed to enter, escaping through the waste-pipe at the top of the other end of the trough. After the water had flown through the trough for about half an hour, it was turned off at F, and connected with D, flowing through B, and thence passing through the rubber tubing from c to f. At f it enters the tube C, and escapes at g into a waste-pipe. The temperatures of the thermometers having been read off, and the position of the screw noted on touching the end of C, the eighteen Bunsen burners were lighted, and the screw turned so as to allow for the expansion of the rod. When the water boiled, and it was found necessary to continue the boiling for about a quarter of an hour before constant readings could be obtained, the temperatures were then read off and the position of the screw again noted on touching the end of C. To take the readings again at low temperatures, the water tap was connected with F, and the water allowed to flow through the trough till that flowing from the waste-pipe had the same temperature as the water from the tap when the connection was again made with d. Screens were placed between the ends of the trough and the tubes B and C, to prevent their being treated by radiation. A thermometer placed near the screw of the measuring apparatus should show no change during the time of the experiments. Such observations should only be deemed reliable which give concordant results on heating and cooling the rod, as the slightest movement in any part of the apparatus will cause large differences in the observed values. In the above table, $T_1 T_2 T_3 T_4$ denote the true temperature of the water in the order in which the determinations were made; $a, b, c,$ the expansion of the rod between those temperatures. The last three columns give the expansion of one degree between the observed temperatures. The length of the rod was 1804 millimètres, and its diameter about 15 millimètres:

The mean co-efficient of expansion of the rod may therefore be taken:

between 0° and 50° = 0·02915, and
between 50° and 100° = 0·03026,

the length of the rod being taken

at 0° = 1804, its length,
at 50° = 1805·4575, and
at 100° = 1808·0260.

The linear expansion of the rod from these data for any temperature between 0° and 100° may be expressed by the formulæ—

$L_t = 1804\ (1 + 0{,}00001555t + 0{,}0000000122t^2)$.

MR. BARFF ON SILICIOUS PAINTING.

On some Applications of Soluble Silicates. By F. S. Barff, *M.A.* (*Cantab.*), *F.C.S. Part I. Silicious Painting.**

The range of colours which can be used in stereochromy is more limited than that which is employed in oil-painting. This limitation, which extends particularly to the reds, may possibly be considered a defect in the system—it is, however, one which it shares equally with fresco. If more brilliant colours are desired a little careful investigation will, without doubt, lead to their discovery. The direction in which to look is among the products of the fusion of silica with metallic oxides. Very fine reds have been produced by cuprous oxide, and analyses have lately been made of pieces of mosaic, of modern manufacture, lately brought from Russia, very beautiful in colour, and comprising an extensive range of tints. The further prosecution of this branch of this subject would lead us beyond the scope of the present article; it more properly belongs to the consideration of mosaics and enamels, and is a matter of considerable importance and of increasing in-

* Concluded. See p. 20 (April 13).

terest. It is, however, necessary to state for the guidance of those who may be disposed to try silicious painting, that they should be very careful in the selection of their colours, as they may be disheartened in the outset by failures which could easily be avoided by observing certain precautions—one specially necessary is, that the colours be *quite pure*. The best English makers would, no doubt, supply them if requested; but they can easily be obtained from Munich, where several manufacturing chemists have for many years been engaged in their production for fresco painting. The after treatment with aluminate and silicate of potash must be the work of the experimenter himself, and no difficulty will be encountered if the directions previously given be carefully followed. It must be borne in mind that all colours employed must be of such a nature that they are not injured by potash. Brunswick greens, orange and lemon chrome (which are chromates of lead), vegetable colours, etc., are unfit for silicious painting; vermilion does not answer well, as it blackens by exposure after some time. Iron reds of all tints; chrome red, ultramarine blue and green, cobalt colours (such as Thénard's blue, which is an oxide of cobalt and alumina, and Rinman's green, in which zinc replaces alumina), yellow ochres, cadmium yellow, umbers, and siennas, may be safely used. Venetian red is not admissible; it contains sulphate of lime, and sets into a lumpy mass when mixed with a soluble silicate. Drop black, carefully prepared, stands well. Several whites may be employed with good effect, but the best is a mixture of sulphate of baryta and carbonate of lime. Where a very pure white is required oxide of zinc answers well. It seems peculiarly fitted for the purpose, as zinc and alumina form the mineral gahnite; and experience has proved that those substances which form enduring natural compounds give very satisfactory results by their combined action in such applications as that in the consideration of which we are at present engaged. When sulphate of baryta and carbonate of lime are used they should be well mixed in equal proportions and ground with a muller on a marble slab; if mixed in water, and allowed to settle, the baryta, being heavy, sinks to the bottom, and the mixture is uneven. In the consideration of another application of soluble silicates, their action on sulphate of baryta and carbonate of lime will be treated of more at length. All colours should be ground fine in water and kept in pots, covered with bladder, ready for use.

The next subject, and one of the utmost importance, is the ground on which silicious painting should be executed. Old plastered walls are not suited for it, because it is customary to mix plaster of Paris with the lime to cause it to set more rapidly, and plaster of Paris interferes with the proper action of soluble silicates. It is only necessary to mix a small quantity of plaster of Paris with silicate of soda or potash to be convinced of this fact; the compound at first sets very rapidly, forming a hard mass; but when dry it splits up and is easily reduced to powder. It is therefore better not to attempt silicious painting on a ground the constituents of which are unknown. The skimming coat of an old wall should be removed and replaced by another from about one eighth to a quarter of an inch in thickness—and this ought to be made with old lime, that is, lime which has been run for some time; it should be at least one year old; this must be mixed with clean, sharp, fresh-water sand, and marble dust, from which the fine powder has been sifted, so that the grains are about the size of those of ordinary gunpowder; the marble dust is not absolutely necessary, but when paintings upon which time is to be expended are required, it is better to give some extra care to the preparation of the ground. The use of powdered marble is also recommended by Dr. Fuchs, whose advice is always deserving of careful consideration, and soluble silicates unite with it very firmly; still, experiments made on a ground of only lime and sand have answered most satisfactorily. It is desirable to have the painting-ground very absorbent, and the less lime that is used in its preparation the better, provided the particles of sand hold sufficiently well together to allow of the first application of the silicious solution. The plaster should be dressed with a wooden float, and should be left with an even granular surface. It should afterwards be allowed to get thoroughly dry, so that the suction may be perfect. Care must be taken that the lime be very pure and free from matters which, by forming compounds with the alkali of the silicate, might cause efflorescence and form crystalline substances, which tend to break up the surface, because, crystallising from within, they push before them the particles which impede their development. Many successful trials have been made with Portland cement instead of lime—a larger quantity of sand being mixed with it than when with lime; but difficulties have been experienced from its uncertain composition, as it is generally obtained, many samples containing sulphates and other injurious matters, so that its action cannot be depended upon. Instead of powdered marble, dolomite or magnesian limestone can be advantageously used. Magnesia enters into a firm union both with silica and alumina; and silica seems to give the

most stable compounds where it has several bases to unite with, and where it can satisfy its propensity for forming complex combinations. When a new wall has to be prepared it can be treated in the usual way till the finishing coat, which can be put on in the same manner as has been recommended in the case of an old one—pure and clean materials and an absorbent even surface being *absolutely* necessary to the success of the subsequent painting. When the plaster is sufficiently dry and has been exposed for some days to the air, so as to lose its causticity, it may be coated with a weak solution of the silicious mixture. The method of preparing it has already been given; it is better, perhaps, to repeat it here; silicate of potash of sp. gr. 1·2 is to be mixed with aluminate of potash sp. gr. 1·12; this solution should be diluted with its bulk of water, in order that it may penetrate deeper into the coating of the wall. The application should be repeated till suction ceases—that is, till the surface remains wet for a minute or two after it has been applied. At first, the liquid will be drawn from the brush by the absorption of the plaster, but after one or two coats this will cease, and the wall will show a glossy-wet surface for a short time. When dry it will be in a proper state for the reception of the painting; but between each coat time must be allowed for drying—and the longer the time given the more perfect will be the penetration and the better the preparation of the ground, because, on the evaporation of the water, the silico-aluminate contracts, and minute cracks are left, which are filled in by the after-washes. Care must be taken not to leave the slightest gloss on the surface of the wall, as a certain amount of future absorption is necessary to draw in some of the liquid used in laying in the colours, so that the bond between their particles and the constituents of the painting-ground may be intimate and complete. This is effected, first, by the penetration to a certain depth of the silico-aluminate which binds together the lime and sand—covering the latter perfectly and uniting it to every minute particle of lime in contact with it; the lower parts of the surface are thoroughly impregnated, but those more superficial only partially. The painting vehicle, which is of very nearly the same composition as that used for binding the ground, fixes the colours to that part of it which has not been thoroughly saturated, and these are all bound together by the after-fixing solution. It is hardly possible to conceive a more compact mass than is here formed, and one which, by a chemical union of all the materials employed, is more likely to ensure a permanent result. It was the conviction that a system, in which some of the substances used had in part to be got rid of by a slow subsequent action, must contain in it the elements of disintegration and decay, which led to investigations resulting in the discovery of a solution containing the elements of some natural silicates, and which was available for the purposes of art manipulations. If any excess of uncombined potash remain in the liquid, it is very small, and is soon taken up by the lime and sand of the ground, with which it forms insoluble compounds. This is proved to be the case by the absence of efflorescence and the unchanged condition of the picture under ordinary atmospheric influences.

The solutions employed in the foregoing operations are, in the main, the same, differing principally in their densities. There is, however, some slight difference in their composition—that which is used for impregnating the colours should be made with a silicate of potash, as nearly as possible saturated with silica. Silicate of potash and aluminate of potash can be obtained from Mr. Rumney, manufacturing chemist, Ardwick, Manchester, and from Messrs. Hopkin and Williams, of New Cavendish Street, in a state of considerable purity. Silicate of potash can be made by fusing together white sand (such as is used by flint-glass manufacturers) and carbonate of potash, in the proportion of 10 parts of carbonate of potash to 15 of sand—the sand should be first washed with dilute hydrochloric acid, and then fritted. The fused silicate should be reduced to a fine powder and boiled for some time, being constantly stirred; a dilute solution of silicate of potash will thus be obtained, which can be concentrated by evaporation—this is best done on a water-bath. From a portion of this solution the silica should be precipitated by hydrochloric acid and ammonia, and well washed. The hydrated silica thus obtained must be added little by little to the silicate of potash; heated in a water-bath, it is quickly dissolved at first, and the addition must be continued till it ceases to be taken up. This saturated silicate at sp. gr. 1·2, mixed with aluminate of potash, sp. gr. 1·12, should be employed for saturating the ground and impregnating the colours. For the painting-vehicle the silicate, as at first prepared, before saturation with hydrated silica, should be mixed with the aluminate of potash, both being of the same densities as before; and this solution should, when used, be diluted, the object being to have only just enough silicate and aluminate present to fasten the colours, so that they may be painted over with the same ease as in oil, encaustic or distemper painting. It has been already mentioned that the mixed silicate and aluminate thus prepared will remain in solution for

twenty-four hours; after ten or twelve it sometimes begins to thicken, and in this condition it is not so fit for use as when it is thinner; it is, therefore, advisable to mix each day only sufficient for its requirements. After the solution has begun to set, it cannot be reduced with water so as to render it available. Attention should be paid to this fact, as the colours applied with the liquid in the viscid condition crack on drying and peel off. There is, however, no danger of this happening if the solution be used within the time stated. Before the picture is commenced, after the wall has been prepared as directed, it should be moistened slightly with water, to prevent the suction drawing away the liquid from the colours too rapidly. It should not be made *wet*, but simply damp, and this moistening must be repeated from time to time, as the artist finds it requisite—of this he will be the best judge.

It is only necessary to remark further that the brushes used in painting should be frequently washed, as the colours cake and harden upon them, and the potash, if left for any length of time in contact with the bristles, destroys them. When the painting is finished it only remains to fix it; this is effected by applying dilute solutions of the same mixture as was used in binding the ground—and only sufficient should be employed for the purpose; any excess will dry out glossy, and it will be some time before this gloss disappears. If a large excess be used it will form a coating which will impair the brilliancy of the picture. Ornamental painting of all kinds, plain painting, stencilling—in fact, whatever can be none in other systems—may be accomplished by this method. It differs from that introduced in Munich, by being more simple and easy of application. In Dr. Fuchs' stereochromy the colours are laid on with water, and the fixing process is subsequent to the completion of the picture. If colours are used without any binding material they are easily removed, and great care is requisite to prevent their running into one another. The process of applying the fixing solution is also one of greater delicacy. These and other difficulties prevent its general adoption, as it can only be used by careful and skilful operators. Now, if any new system of painting is to become general, its principal recommendation must be the simplicity of its application, because, to induce commercial artists to adopt it, or even give it a trial, it must not be subject to frequent failures through the mistakes of workmen consequent upon the excessive care needed in its prosecution; for this reason the Munich system can never come into general use for decorative art, which is in this country almost invariably carried on as a trade, because it would require workmen of too high qualifications. These objections do not hold with respect to the system here recommended, whose treatment requires no more than ordinary care after the knowledge of its manipulations has been acquired. It is difficult to leave this subject without expressing a hope that some of our leading chemists will endeavour to spare time from the engrossing interest of their higher and more speculative researches to help an art which greatly needs it; nothing can be more unsatisfactory, from a scientific point of view, than an artist's palette and the collection of materials which he has at his disposal. In most cases, ignorant of their nature, it cannot be laid to his charge that his best efforts and noblest works are often but *perishable* monuments of his greatness. The fate of the frescoes in the Houses of Parliament call on Science to come to the assistance of Art, and to endeavour to put into her hands a means of perpetuating conceptions which are among the highest inspirations of our nature.

MR. DRAPER ON FRUIT ESSENCES.

Practical Notes on Fruit Essences and Artificial Odours. By HARRY NAPIER DRAPER, *F.C.S.**

THE artificial formation in the laboratory of substances existing in nature has from the very earliest times occupied the attention of chemists, and may, indeed, be said to have lain at the foundation of chemistry itself. The alchemists, in proposing to themselves the problem of the production of gold, studied those characters which were united in gold alone, and endeavoured either to combine them in one substance by bringing together other bodies which possessed one or more of the required properties, or they sought to eliminate from some one body the property in which alone it differed from gold. This was, of course, simply the putting into practice the theory which was at the time accepted as truth. Bodies were believed to owe their distinctive properties to the existence in them of an inherent principle. Lime was caustic because it contained the caustic principle; vinegar sour, because of the presence in it of a primitive acid principle; inflammability was ascribed to the presence of sulphur, volatility to that of mercury. "To every effect a term was applied: this term was called the cause, and it served as the explanation of the effect."

When we consider the remarkable system of classification which was one of the results of this theory, it is not surprising that the artificial formation of gold was not accomplished.

* First communication.

When, however, oxygen had been discovered; when Madame Lavoisier had publicly committed to the flames the theory of phlogiston; when the balance was made to test the truth of speculation and assertion—when, in short, alchemy had become chemistry and analysis preceded synthesis, it was somewhat unfortunately discovered that gold was a simple, undecomposable substance. Were it not so, we might, with our present knowledge, set about its production with almost the certainty of success. Liebig puts this relation of analysis to synthesis very forcibly.

"The chemist, by his questions, compels a mineral to speak, to disclose its composition; it tells him that it contains sulphur, iron, chromium, silica, alumina, or any other word of the chemical language of phenomena, arranged in a certain order. This is Chemical Analysis. Then, again, the language of phenomena leads the chemist to new combination, from which he derives innumerable useful truths that are applicable to the improvement of manufactures and arts, to the preparation of remedies and to metallurgy. He has succeeded in deciphering the word *ultramarine*. The next step is to construct this word in a tangible form, to reproduce ultramarine with all its properties."*

The production of this very ultramarine was one of the triumphs of synthetical chemistry, and the discovery of Guimet doubtless did much to encourage others to attempt like conquests. Experiments of this kind will always naturally take a direction in which a successful result is likely to meet with pecuniary reward; and it is this cause which has operated in restricting the practical synthesis of inorganic compounds found in nature (minerals) to the artificial production of gems.

With organic compounds the case is different. The stimulus to attempt their synthesis has been twofold. There has been, firstly, that derived from the desire to produce bodies which it was at one time believed were the results only of the so-called *vital force;* and secondly, that which has its origin in the attractive idea of forming rare bodies out of others which are common. During the thirty years which have elapsed since it was discovered that this "vital force" played no essential part in the formation of organic bodies, more than seven hundred such bodies have been artificially produced, and their number is daily on the increase.

At the London Exhibition of 1851, attention was for the first time generally directed to a class of organic compounds which, although they had before been doubtless known to those who were most practically interested in them, had never collectively been described. These were the bodies which are now usually recognised under the generic name of *fruit essences.* A fruit essence, in the sense in which the term is now understood, is an artificially formed compound which possesses in a degree more or less marked the odour of some natural vegetable product; and for the object of these notes I do not think it necessary to draw any line of separation between *odours*, properly so called, and *flavours*, or, to use a better term—for which I am indebted to, I think, Dr. Lankester—*sapours*. This distinction would not, under any circumstances, be an easy one to make; and it is moreover practically quite unimportant.

The "fruit essences" which were shown at the 1851 Exhibition were few in number, and in the "Report of the Juries" Dr. Hofmann confines his notice of them to the five following compounds:—*Pear Oil, Apple Oil, Pineapple Oil, Cognac Oil,* and *Artificial Oil of Bitter Almonds.* Since the time that this report was written, so much progress has been made in this somewhat limited branch of technology, that it is now possible to produce a tolerably fair imitation of the odour of—with perhaps not more than three or four exceptions—every known fruit. At the same time, it must be admitted that the number of compounds having a definite chemical constitution, and at the same time an odour simulating that of a fruit—like, for example, acetate of amyl—has not been considerably augmented. The existing bodies of this kind are used as *bases* with which, by the addition of essential oils, other imitations are produced. It must, therefore, be borne in mind that there are two classes of fruit essences: one (of which butyric ether and acetate of amyl may be taken as types) in which synthetical chemistry has produced, not a resemblance to, but the *actual* odour of the fruit; and another in which, working without rule, a fruit odour is compounded of ethers and essential oils, just in the same way as a perfumer imitates the fragrance of the primrose or wallflower.

The following list includes, as far as I know, all the odours which may be successfully imitated by a single substance of known chemical composition; for it is too much to say that in each of these instances we have obtained, not only an approximation to the odour of the fruit, but have produced by means precisely similar to those employed by nature. On the other hand, there are a few instances—as, for example, those of the odours of pineapple and pear—in which the resemblance is so exact that there is scarcely any room for doubt

* 'Letters,' 4th edition, p. 10.

as to the identity of the products of nature and those of the laboratory. Thus—

The Odour of	Is closely similated by
Bitter Almond	Nitrobenzol.
Jargonelle Pear	Acetate of Amyl.
Pineapple	Butyrate of Ethyl.
Apple.............................	Valerianate of Amyl.
Quince	Pelargonate of Ethyl.
Greengage	Œnanthylate of Ethyl.
Melon	Sebacate of Ethyl.
Mulberry	Suberate of Ethyl.
Gaultheria procumbens	Salicylate of Methyl.
Spirea Ulmaria..................	Salicylous Acid.

LABORATORY NOTES.

Analysis of Commercial Caustic Soda Crystals.

CAUSTIC soda has now become an extensive article of commerce, although its birth in this sense may be considered coeval with the Exhibition of 1851. In Dr. Hofmann's celebrated Report on the Exhibition of 1862, page 28, will be found the following remark:—"When caustic soda is kept for some time in the state of igneous fusion, the oxide of iron is deposited in the anhydrous state, and it seems also that the alumina is completely, separated in the form of a crystalline silicate." (Dr. Pauli.) "An observation," says Dr. Hofmann, "in which the analytical chemist must feel particularly interested." I have, therefore, thought it desirable to publish the following results. The analysis of the crystals of soda was performed in Dr. Apjohn's Laboratory (Trinity College); that gentleman having sent me the results of the examination in return for the specimen I supplied. The second column gives the composition of fused soda, also determined by Dr. Apjohn, and is here inserted for comparison:

	CRYSTALLISED SODA.*	FUSED SODA.†
Soda	51·77	63·69
Combined water	14·54	18·49
Water of crystallization.........	30·85	0·74
Carbonate of sodium............	0·57	2·75
Chloride of sodium............	1·88	6·96
Sulphate of sodium............	0·39	7·23
Silica	—	0·11
Iron and alumina	—	0·03
Potash	—	trace.
	100·	100·

Neglecting the impurities, which, in the crystals only amount to 2·84 per cent., the analysis agrees very nearly with the formula $NaHO.H_2O$.‡ These crystals which can now be procured in quantity, are in massive prisms, formed by the aggregation of tough plates—the crystals are monoclinic. S. Rose ('Jahresb.,' 1863) has, I believe, given a description of the form of the soda crystal.

The analytical results tabulated above prove that chemically pure soda may be procured commercially, and in any quantity—the crystals analysed may be almost viewed as such, whilst a re-crystallisation would no doubt give a product of even greater purity, the 2·84 per cent. of foreign matter being probably due to the mechanical admixture of mother-liquor. Another point in connection with this product is its freedom from carbonic acid and permanent causticity. The results verify Dr. Pauli's statement, that the alumina is deposited as a crystalline silicate. On evaporating the "red liquors," or crude caustic solutions, a point is at last reached at which the silica, iron, and alumina, are entirely deposited, for the small quantities found in the fused product are most probably only due to imperfect mechanical separation. I find that the inferior qualities of fused caustic soda contain large quantities of nitrate, and frequently traces of nitrite of sodium.

C. R. C. TICHBORNE.

Apothecaries' Hall of Ireland.

* From Mr. Gossage.
† From Messrs. R. Dale and Co., Manchester.
‡ Given in Watts' 'Dictionary of Chemistry,' p. 339, vol. v, as having the following composition:—$2NaHO.7H_2O$.

Qualitative Separation of Arsenic, Antimony, and Tin, from Mercury and Copper.

I am not aware whether the following method is used in qualitative analysis. I have found it very useful, because it is a good *separation*, a thing of considerable importance, and one not always attainable by the plans usually adopted. Sulphide of ammonium dissolves cupric sulphide to a very appreciable extent; it is not, therefore, advisable to use it as a solvent for sulphides when they are wanted free from copper. This property of sulphide of ammonium often causes considerable inconvenience in the qualitative analysis of mixtures containing the metals precipitable by hydric sulphide in an acid solution. After thorough precipitation by hydric sulphide, the sulphides having been well washed, sodic sulphydrate, NaHS, will dissolve the sulphides of arsenic, antimony, tin, and *all* the mercuric sulphide; the action is very rapid, much more so than that of sulphide of ammonium, which does *not* dissolve mercuric sulphide at all. Now, sodic sulphydrate is not a solvent for cupric sulphide. We have, therefore, here the means of making a very clean and perfect *separation* of arsenic, antimony, and tin, from all the other metals of this group.

The method I have employed is as follows:—I heat the mixed sulphides with sodic sulphydrate, so that the sulphides of arsenic, antimony, tin, and mercury, may be dissolved out; and after reprecipitation with hydrochloric acid, I wash and dissolve the sulphides of arsenic, antimony, and tin, with sulphide of ammonium. The whole of the mercury is isolated at this stage of the analysis, which is a matter of great convenience, and the arsenic, antimony, and tin are perfectly free from any trace of copper. Some trouble is often experienced in separating the arsenic, antimony, and tin, without having recourse to Marsh's test. The method generally adopted is to dissolve the arsenic sulphide with carbonate of ammonium. In this case

some antimony is often dissolved at the same time. In order to separate it, if the mixture be neutralised with hydrochloric acid and the precipitated sulphides be boiled with nitric acid till nearly the whole of the acid is expelled, they are converted into arsenic acid and antimonic acid; the former can be dissolved out with water, the latter remaining insoluble. Any confirmatory tests required can be applied to the arsenic, such as reduction with carbon, conversion into arsenious acid, the silver and copper reactions, etc. The antimony and tin may be separated in the usual way by metallic iron, and the tin, which after this action exists as a stannous chloride in the solution, may be discovered by its reducing action on mercuric chloride. The antimony which was precipitated by the iron in the metallic state can be dissolved by boiling in tartaric acid, with free access of air, and may be determined by acidulating with hydrochloric acid and precipitating with hydric sulphide. I mention this latter separation, not that it is original, but because I have found its order very convenient, and I think it will be found useful by those students who are not as yet well versed in analysis.

F. S. Barff.

University College Laboratory.

Organic Impurities in the Waters of Towns.

For some years past much attention has been paid to the organic impurities met with in the waters supplying towns; and very reasonably so, when it is borne in mind that these organic impurities are responsible, for much of the unhealthiness with which towns are sometimes afflicted.

At present there are two methods in vogue for the estimation of these impurities. The one is to measure the amount of permanganate of potash deoxidised by a given volume of water; the other is to evaporate down a given volume of the water, and then make an estimation of organic matter in the dry residue. The former of these methods has recently fallen into rather unmerited neglect, whilst the latter has risen into unmerited favour.

It seems to the writer of this notice that the advocates of an organic analysis of the dry residue have overlooked the cardinal fact of the case. Organic matters in general, with the exception of certain salts of the fatty acids, and a few other very stable compounds, suffer a slow decomposition when subjected to the prolonged action of air and water at temperatures bordering on 100° C. This is especially true of sugar, albumen, and urea, and, in fact, of those very impurities whose presence it is so important to recognise in waters intended for the supply of towns. Such being the fact, it will be obvious that during the evaporation of a litre of water the organic matter will be more or less completely decomposed, so that the organic matter found in the residue will be no measure of that originally existing in the water. This conclusion has been confirmed by Messrs. Chapman and Smith, who have shown that if a gramme of organic matter be put into a litre of water the residue from that water may be made to contain almost any amount of organic matter considerably short of a gramme, by a proper management of the evaporation. In general, the quicker the evaporation the greater the residual organic matter. We cannot, therefore, depend upon an examination of the dry residue for the purpose of deciding upon the freedom of a water from organic impurities.

But, whilst condemning the method in use, I have to propose a substitute for it.

The organic impurities to be dreaded in a water are nitrogenous. During the evaporation of a water these nitrogenous compounds give up their nitrogen in the form of ammonia. Distil, therefore, a given volume of the water in a retort, and estimate the ammonia in the distillate, and you have a trustworthy measure of the much-dreaded organic impurities in your water.

Messrs. Chapman and Smith, who have arrived independently at the same conclusion as myself, are at present occupied in an attempt to measure these organic impurities by a determination of the ammonia evolved during the distillation of the water. Satisfactory experimental results have already been obtained.

J. Alfred Wanklyn.

London Institution.

EDITORIAL NOTES.

THE WAGES OF SCIENCE.

Sydney Smith used to say that everything in this world was rewarded in the inverse ratio of its worth. The witty divine had learnt this truth from observation of other men's labours, and enunciated it in a spirit of pleasant cynicism. They who have tied themselves to the chariot-wheels of pure science look upon it as an old old story, verified day by day in their own experience, and are excusable if they sometimes think it a cruel truth and repeat it in vexation and bitterness of heart. It is easy for the outside world, for the dilettanti, and for the Philistines, to say in a light and airy way that science is its own reward—that work which is in itself a pleasure cannot expect to meet with a gross and material payment. The daily life of a scientific man, they tell you, must be exceedingly delightful, and they only regret that the cares and press of business, or a mistaken providence, will not allow them to devote themselves as they would wish to some particular branch of inquiry in which they feel and always have felt the profoundest interest. But the man into whose soul science has entered as an iron, to whom scientific truth is a reality of the sternest and weightiest kind, not a fringe or pleasing ornament, but the very core of human thought, is only fretted by such idle remarks as these. He thinks he is in at least quite as good a position as the gay merchant or the successful professional man to know how far science is its own reward. But the matter

to him is not a matter of rewards at all, in the ordinary sense of the word. They look upon science as an Olympian game, in which the crown is honour, or at best fame, and in which they would fain join were it not for the dust and heat of the running. He sees in science far-stretching fields white unto the harvest, while mankind is famishing for want of truth—fields which are not reaped because the labourer is turned away by poverty before he can put the sickle to the ear. He feels it a crying wrong that what scientific work is done at all, especially in this country, is done with the loins girded for other labours, and done in haste and therefore is too often imperfect and immature. He sees the young men of science labour in fear and anxiety, with the wolf clamouring at the door, amid constant temptations to gain an early notoriety by flash results and counterfeit discoveries. He sees the middle-aged men, with the wolf only partially appeased, worried by other enemies in the shape of rich or noble idlers, who think that other men's time is of no more value than their own, and compelled to waste on the treadwheel of tuition the strength that ought to be put out in the field of original research. He sees the old men too often succumb wholly to the pressure of adversity, or, giving up their former ardour, quietly eat their lotus in some post which is at the same time a reason and excuse for abstaining from work.

The man of science thinks, we repeat, that these are cruel wrongs, but they are wrongs which injure science, and, therefore, which injure the world infinitely more than they hurt scientific men.

Science is so far its own reward that the life of a scientific man is one which he would not readily change. But scientific men, instead of being few, ought to be many; to that end the badge of science ought not to mean the same thing as that of poverty. Their daily labour, instead of being the odds and ends of spare hours, ought to be a fair day's work; to that end they ought to have a fair day's wage. How this can be best brought about is a very difficult matter. We propose, at some future time, to return to it.

The constant influx of important communications from eminent men shows that our anticipations were not ill founded. We believed that a weekly medium for the publication of Chemical and Physical researches was wanted, and we may point to our pages for justification of our belief. We have now to announce the publication next week of an elaborate paper "On the Higher Homologues of Chinoline" by Mr. Greville Williams, F.R.S.

CORRESPONDENCE.

BLACK-BALLING IN THE CHEMICAL SOCIETY.

To the Editor of The Laboratory.

Sir,—At a meeting of the Chemical Society, April 18, one of the two candidates proposed for election was black-balled; the balloting was, however, declared by the chairman at the following meeting to have been informal, and the names of the two gentlemen were again read "for the first time." On Thursday, May 2, three other candidates were rejected and two elected. On this occasion the black-balls were numerous and nearly equal in all cases. Some members of the Society seem desirous of bringing it into notice by proceedings very different from those of other learned societies, and of giving it a not very enviable notoriety.

It can hardly be that the ballot was here used for the purpose of excluding persons unqualified by social position or want of respectability. With regard to scientific qualification, their proposers stood their sponsors, and no other guarantees of intellectual fitness have ever been required for the Fellowship. This sudden and strange action taken by certain persons, needs explanation and a full investigation; otherwise it will cause irreparable injury to the Society, so lately declared by the President to be in a healthy and flourishing condition. It was recently stated from the chair that the Council had contemplated raising the standard for admission to the Fellowship. Can it be that zealous members, taking up this suggestion, have determined to constitute themselves judges of the fitness of candidates, and have forestalled the Council? If this be so, the question arises—What is the required standard of qualification? Who is to judge of it? Enough was heard at the last meeting to make a *physicist* tremble for his chance of election if individual members are to judge him; he might feel pretty sure of getting one black-ball at least if he held the accepted views on magnetic polarity, and, *ex uno disce omnes*, we know not how many more. Moreover, are all the existing Fellows individually competent to form a judgment as to *chemical* qualifications? The very proposal to raise the standard of admission implies that they are not, even if other proofs in certain cases were wanting.

Nothing is more destructive to a society than the formation within it of a party, acting independently and without the sanction of authority, for what they suppose to be its reformation; and the sooner the Fellows of the Chemical Society unite to put down such a combination the better. What Fellow who respects himself and regards the feelings of others would nominate any one for election after what has just occurred? Four gentlemen have been rejected. Why? Because they had not those social and gentlemanly qualifications necessary for the Fellowship? This will hardly be admitted unless their position as manufacturing chemists be considered a bar to admission. If this be really the case, are manufacturers ineligible? Such men, by expending their wealth and by enterprise, render the discoveries of scientific

chemists useful to the public, and are themselves frequently men of very considerable scientific attainments, and to whom, doubtless, many a poor F.C.S. would humbly bow for an engagement at the rate of three or four hundreds a year, or even less. One would scarcely imagine that such feelings could have place among members of a body whose pursuits are scientific; for science can hardly make distinctions of birth and social position when some of its brightest ornaments have risen from humble stations by the force of their own natural greatness.

But whatever may have been the motive in the late black-balling, those Fellows who wish well to the Society should lose no time in having the matter set right. It would be well if some members, not on the Council, would call a meeting, where the subject might be fully considered, and such action taken as would prevent a recurrence of what most persons must feel to be a disgrace, rather to the Society than to the victims of a sadly misplaced confidence. The Council, formed, for the most part, of men who have the respect and confidence of the Fellows, would, no doubt, listen to any reasonable suggestion, and meet the wishes of the majority, as far as they might be conducive to the good of the Society; but it is from the Council that important changes should emanate, nor is it likely that they will be coerced into the adoption of any course by a clique which does not scruple to wrest from its legitimate object a weapon of defence, and use it as one of offence, and that, too, in a very offensive manner. It may be necessary to render more stringent the entrance qualification for Fellows, and this we are told by high authority is under consideration. But till the change is made it is unjust to black-ball those who, judging from precedent, allow themselves to be proposed, and who are in most respects fit and proper persons to be admitted, simply because they fall short of the standard set up, it may be, by those who, if a stricter ordeal had awaited them at the time of their candidature, would, perhaps, never have had the opportunity of troubling the Society.

A FELLOW.

To the Editor of THE LABORATORY.

SIR,—I find that the black-balling which took place last week at the Chemical Society has been misunderstood, or perhaps I should say not understood. I therefore write to explain the motives of one, at any rate, of the black-ballers. If we look in the newspapers we shall see something like the following:—"Patents.—Mr. ——, F.C.S., Member of the Society of Arts, British, Foreign, and Colonial Patent Agent, gives special attention to Inventions, etc." The above has been copied from a paper which is sure to be seen by many chemists; and as Mr. —— is otherwise unknown to fame, is nothing more nor less than an insult offered to the Chemical Society in its corporate capacity. To prevent this, and the like of this, has been my object, and this object I hope to attain by black-balling all men who come up to the Chemical Society without either the strongest recommendations from many *different* chemists, or the still stronger recommendation of having already produced good work, either in chemistry or the allied sciences.

I ask, what right has any man not a chemist, and not known among chemists, to feel himself aggrieved at being refused admission to the Society unless he comes under one or other of these classes. And yet I question whether 10 per cent. of those admitted are known, either personally or by reputation, to five of the men who vote them into the Society.

No papers were read at the Society the night of these elections. How came it, then, that we had so full a meeting? I have been informed that some members of the Society received letters from the Secretary, requesting them to attend. Why request men to attend when nothing was to be read? Am I going too far when I suggest the possibility of an attempt being made to bring official influence to bear on the result of an election?

I am, Sir, yours very truly,

A BLACK-BALL.

MAGNETISM APPLIED TO CHEMISTRY.

To the Editor of THE LABORATORY.

SIR,—During the discussion at the last meeting of the Chemical Society Prof. Foster said that the application of a second magnet, as figured below, would increase the power of the first magnet.

No. 2

No. 1

Mr. Chapman, who said that this was a mistake, and that the power of the magnet would be diminished by the application of No. 2, was, as those of your readers who were present at the meeting will recollect, received with uproarious demonstrations of disapproval.

The state of the matter is just this:—If magnet No. 2 be of equal strength to No. 1, then the result will be a total magnet of exactly the same strength as at the beginning. If No. 2 be weaker than No. 1, then the result will be a total magnet of less power than No. 1; and if No. 2 be of greater power than No. 1, the result will be a total magnet stronger than No. 1.

The comparison of a chemical atom or molecule to a magnet is radically vicious and productive of confusion of thought. The characteristic of a magnet is that it exhibits the two opposite polarities to an equal extent. A magnet with a powerful south pole has, of necessity, an equally powerful north pole.

Now, we find chemical atoms or molecules powerfully positive or powerfully negative, but not powerfully positive and negative at one and the same time. If there is anything in nature which the chemical molecule does not resemble it is the magnet. The molecule of chlorine, for instance, is, as a whole, powerfully electro-negative, and chemists with magnetic tendencies have been overjoyed to make the

observation that the two atoms forming the molecule are not *electro-negative* to an *equal* extent, but I never heard of any one imagining that the one was as powerfully electro-positive as the other is electro-negative. Z.

CHEMICAL SOCIETY.

THURSDAY, MAY 2.

Professor W. A. Miller, M.D., LLD., V.P.R.S., Vice-President, in the chair.

The minutes of the previous meeting having been read and confirmed, a long list of donations to the Library were announced, and accepted with a vote of thanks.

The Chairman observed that the balloting for Mr. William Phipson Beale and Mr. Alfred Coleman, at the last meeting, was invalid, because less than twelve Fellows had voted in each case. Therefore their names must be again read "for the first time."

The names in question and the name of a new candidate were then read.

For the second time were read the names of Robert R. Tatlock, Millhouse, Kyles of Bute; and Walter William Fiddes, Southernhaye, Clifton.

The Chairman said that he did not wish it to be thought that the remarks he had made at the anniversary meeting, respecting the measures which the Council had in contemplation for the more stringent admission of Fellows, had any reference to the candidates who had already been proposed.

Five gentlemen who had been proposed for the Fellowship were then ballotted for. On examination of the ballot-boxes the Chairman declared that Mr. John Cargill Brough and Mr. F. W. Peterson had been duly elected Fellows of the Society, but that the votes were adverse to the election of the other three candidates.

The Chairman stated that there were no papers to be read this evening, but he hoped that some Fellows would bring forward subjects for discussion.

Dr. Odling said that, seeing some eminent manufacturing chemists present, he should like to ask them if *the recovery of sulphur from soda-waste* was practised in England, as at the Paris Exhibition he had seen fine specimens of sulphur suitable for the manufacture of gunpowder, said to be recovered from soda-waste. He could not obtain any direct information as to the method employed, but from the inquiries he had made he understood that manganese was employed in the process, which was carried on on a large scale; in fact, it was proposed to make use of all the soda-waste in this manner.

He had also some remarks to make on a subject of more purely scientific interest. He found considerable difficulty in accepting the ordinarily received notions on *combination by saturation of atomicities.* Some time ago he had devoted considerable attention to the subject, but since then much of it had escaped him, so that he must apologise to the members for the manner in which he now presented it to them. There were certain facts in connection with the subject of atomicities which ought not to be overlooked. For instance, nitrogen sometimes combined with *three* atoms of an element, and sometimes with *five*. This was explained by saying that nitrogen had five "atomicities" or "bonds," of which sometimes the whole were saturated, sometimes only three, the other two neutralising or saturating one another. Thus, in ammonia, NH_3, the N had three of the bonds saturated by H_3, the other two neutralising one another. Now, when HCl was presented to the NH_3, combination ensued. This was explained by supposing the H and the Cl of the HCl to saturate the two remaining bonds of the N in NH_3. Now, he found great difficulty in admitting that the chlorine of the hydrochloric acid should separate from the hydrogen, for which it had a great attraction to combine with nitrogen, for which its attraction, was very small. When chlorine and ammonia were brought in contact there was a flash of light, heat was liberated, and, leaving out the intermediate stages of the reaction, the ultimate products were nitrogen and hydrochloric acid. This fact certainly was not in accordance with the supposition that the chlorine should leave the hydrogen in hydrochloric acid to combine with the nitrogen. To mention another instance. When sodium was exposed to dry air it absorbed oxygen and became converted into sodic oxide; if this compound was brought in contact with water a reaction took place, with great evolution of heat, giving sodic hydrate, which no amount of heat would afterwards decompose. Thallic oxide, likewise, gave thallic hydrate, but this differed from the sodic hydrate as it was again resolved by heat into thallic oxide and water. Now, in the reaction between $\left.\begin{matrix}Na\\Na\end{matrix}\right\}O + \left.\begin{matrix}H\\H\end{matrix}\right\}O$, one Na in $\left.\begin{matrix}Na\\Na\end{matrix}\right\}O$ was unburned, being displaced by H; in $\left.\begin{matrix}H\\H\end{matrix}\right\}O$, one H was unburned, Na taking its place, giving $\left.\begin{matrix}Na\\H\end{matrix}\right\}O + \left.\begin{matrix}H\\Na\end{matrix}\right\}O$. The amount of heat liberated in one case must be exactly equal to the amount of heat absorbed in the other, so that, leaving out the effect of the solidification of the water, no heat should be rendered sensible. A perfectly similar reaction took place when $\left.\begin{matrix}Tl\\Tl\end{matrix}\right\}O + \left.\begin{matrix}H\\H\end{matrix}\right\}O$ were brought in contact, but when the resulting thallic hydrate was heated it gave water and thallic oxide. From the different actions which heat had on thallic and sodic oxides, it might be inferred that the relations between Na and H and between Tl and H were different—that there was an attraction or tie wanting in the thallium which was present in the sodium. Somewhat similar reactions took place between magnesic, calcic, and baric oxides and water, but the resulting hydrates behaved very differently from one another when heated. The magnesic hydrate gave up its water at a comparatively low temperature; calcic hydrate required a much higher heat, whilst baric hydrate was practically undecomposable. He therefore inferred that, as in the case of sodic hydrate, there was a tie between the barium and hydrogen which was wanting in the calcium and magnesium hydrates. There was something here to be ex-

plained which it seemed to him the doctrine of atomicity did not reach.

Professor Williamson said that chemists did not sufficiently take into consideration the fact that an atom in combination was very different from an uncombined atom. Thus, the oxygen in oxide of silver was in a different state and had different properties from free oxygen. In the union of HCl with NH_3 the nitrogen of the ammonia and the chlorine of the hydrochloric acid were different from what they were in an uncombined state. The chlorine did not unite directly with the nitrogen, but with the nitrogen and hydrogen together. In this case nitrogen behaved more like a metal. The affinity of nitrogen for nitrogen in nitride of nitrogen, and chlorine for chlorine in chloride of chlorine, was greater than that of chlorine for nitrogen in chloride of nitrogen. It was the same in the case of the hydrates; the affinity of H for KO was greater than the affinity of H for HO, consequently in the union of KO and H greater force or more heat was rendered sensible than in the union of HO and H. He further remarked that some eminent Continental chemists, Kekulé, for instance, seemed to use the word atomicity in a different sense from the word equivalency, but he could not see that it meant more than equivalency. The use of bonds was productive of inconvenience, as one was apt to look upon them as a material image.

Dr. Miller said it seemed to him that the term atomicity implied a theory, whilst equivalency simply referred to facts, and therefore he preferred the use of the latter word. The term atomicity was something like the term catalysis; we used it to conceal our ignorance or inability to explain facts.

Dr. Thudicum regarded the term atomicity merely in the light of a convenient expression, and believed that many discoveries had resulted from that definition. An atom meant a thing, atomicity a power; thus we defined the property of an atom by its name. He proposed to substitute the term *dynamis*. The power of an atom was measured by its influence on another atom, and the several powers of atoms might be expressed by the terms *dynamis*, *monodynamis*, *didynamis*, etc., while the term equivalent might be employed for the maximum of power. The *dynamisity* of an atom was changeable according to external circumstances. Atoms were held to one another by opposite polarities, but the power that produced this polarity lay beyond the atom. Thus, electricity, heat, etc., induced combinations and split up combinations of atoms.

Professor Foster agreed with Dr. Odling that when the two molecules Na_2O and H_2O were converted into 2NaHO, the change undergone by one molecule was the converse of that undergone by the other, and therefore that it was difficult to understand that the quantity of heat developed in the one case should differ from that absorbed in the other; but he observed that there was no direct proof that the reaction in question was attended with any evolution of heat. When water acted on oxide of sodium a great part of the observed evolution of heat was certainly due to the combination of NaHO with excess of water, and it remains to be proved that this action was not the source of the whole. The conversion of BaO and H_2O into BaH_2O_2 he regarded as a reaction not perfectly comparable with the above, since, in this case, the two molecules BaO and H_2O coalesced into the single molecule BaH_2O_2. With regard to the different behaviour of what appeared to be similarly constituted molecules when subjected to the same treatment, as, for example, that of sodic and thallic hydrates at high temperatures—an instance to which Dr. Odling had referred—he considered that the explanation of them was to be sought in the influence exerted by each atom in a complex molecule upon the properties of all the rest. To help in forming a definite conception of the way in which such an influence might be exerted, he suggested that a diatomic atom (such as O) might be compared with a magnet with its two poles, while monatomic atoms (such as Na and H) might be compared with a single isolated magnetic pole, if such a thing were capable of existing. Then, just as the south pole of a magnet would be strengthened by induction on bringing another south pole into contact with its north pole, so, by bringing an atom of sodium into contact with one pole of an atom of oxygen, the attraction of the other pole for atoms of a certain kind might be increased, although its attraction for sodium might be lessened. If this comparison of a diatomic atom with a magnet was admitted, he pointed out that in all cases, if an atom of a given kind (applied to one pole of a diatomic atom) tended to strengthen the polarity of the latter, an atom of the same kind applied to the other pole would tend to weaken it in an equal degree, and hence that, as a general rule, if two symmetrical molecules (such as NaONa and HOH) came together, the forces with which the atoms were held together would, on the whole, be increased by an interchange of atoms such as would convert the above molecules into NaOH and NaOH. Professor Foster added that he did not offer these remarks as affording a solution of the difficulties pointed out by Dr. Odling, but simply as indicating a direction in which he thought such a solution might reasonably be sought for.

Mr. E. T. Chapman said that he was at first very much struck with Professor Foster's illustration, but that unfortunately it did not hold, as the power of a magnet was weakened by bringing its north pole near the south pole of another magnet. In compound magnets a series of magnetic bars were placed side by side, having their similar poles together, thus strengthening one another.

Professor J. A. Wanklyn disliked the term atomicity, which inferred that the saturating power of an element was unchangeable, and could not see what inconvenience would arise from the supposition that an element like nitrogen under some circumstances was capable of combining with three and sometimes with five atoms.

Dr. Odling said that, although not yet proved it did not seem improbable that one side of the atom of O was + and the other —. It had been suggested that the heat produced in the reaction between $\left.\begin{matrix}Na\\Na\end{matrix}\right\}O$ and $\left.\begin{matrix}H\\H\end{matrix}\right\}O$ was owing to the combination of

the sodic hydrate with excess of water. As the amount of heat produced by dissolving sodic hydrate in water had not yet been determined, he could not say it was impossible. But in the parallel instance of the hydration of SO_3 the amount of heat produced was several hundred times greater than that liberated by the union of sulphuric hydrate with water. He agreed with Dr. Miller, that the use of the term bonds tended to conceal the truth.

The Chairman then adjourned the meeting to the 16th instant.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *May* 6, 1867.

Social gatherings and Scientific Societies—Annual meetings of the Société des Amis des Sciences, of the Delegates of the Scientific Societies of France, and of the Société d'Encouragement—Silkworms and the Senate—Meetings of the Chemical Society of the 3rd inst., and of the Académie of the 29th April—Printers and chemists.

FRANCE is certainly the country for society. No wonder that pepsine, the cure of dyspepsia, should have been invented here, nor that the inventor should distribute his pills gilt and gratis to the honorable members of the Exhibition Juries. The fiercest and the most unexpected attacks are now daily made upon their digestive powers by savants and diplomatists, by manufacturers and ministers. Not to increase indigestion by rest, balls have been added to the entertainment of Jurors by their excellencies the Ministers of State and of Commerce, Rouher and De Forcade. Arrangements have been made for a reception in their honour by the Emperor at the Tuileries. M. Dumas, the highest in fame and position of all French chemists, opens his house to them every Wednesday; M. Frémy, M. Paul Thénard, M. Wurtz, have their respective evenings of reception. All these assemblies seriously affect the scientific club of the Palais Royal. Not overcrowded last Monday, it will be but indifferently attended, I fear, to-night. Most Englishmen of scientific standing have left Paris. Those present last Monday at the club admired some products shown by Professor Fritzsche, of St. Petersburg. This chemist found lately that a nitro-compound of anthracene gives very characteristic crystalline compounds, beautifully coloured, red, yellow, and green, with anthracene, retene, and other colourless hydrocarbons. He showed specimens of these compounds under the microscope, and very liberally distributed samples of them to many of his audience. A paper on the subject has been published in the memoirs of the St. Petersburg Académie.

We have thus happily found our way back from society to science. But science itself now more than ever puts on her best garb and attends one meeting after the other. This week has been overcrowded with scientific meetings. Last Friday chemists had to be present at the same hour at the annual meeting of the *Société de l'Encouragement* (corresponding to the London Society of Arts) and at the meeting of our *Chemical Society*. Being afraid that I shall have overstepped the limits prescribed for this letter before I come to discuss the meeting of the Chemical Society, I will just say that among the strangers present were Professors Kekulé from Ghent, Schrötter from Vienna, and Chancel (associate of Gerhardt in many of his researches) from Montpellier. The meeting of the Société de l'Encouragement must form the subject of a different letter, for to-day, besides the Académie, two more annual meetings claim attention, one being that of the noblest of all scientific unions, the *Société des Amis des Sciences*. This body assists French savants who, preferring fame to wealth, truth to gain, and philosophical to material labour, suffer for such improvidence in their own persons, or, worse, in that of their orphans and widows.

Founded ten years ago by the great Thénard, whose son, Baron Paul Thénard, now holds the office of treasurer, this society has been the means of rescuing many of the noblest minds from despair and misery. The number of subscribers paying a minimum of 10 francs annually now approaches 3000. The receipts during the last ten years have been 571,686 francs, 177,343 of which have been spent in charity, and 60,510 for general expenses, while 333,834 francs now constitute the capital of the society. Last year's receipts (75,290 francs) have been swelled by a legacy of 1000 francs from the late M. Verdet, and by a gift of 10,000 francs, the history of which deserves to be specially mentioned. A great distiller at Brussels, M. Claes, having been accused of defrauding the custom house of his country, applied for certificates to some of the best-known chemists of Paris, viz., MM. Dumas, Wurtz, Caron, Friedel, Le Blanc, Pasteur, Henry St. Claire Deville, and Dubrunfault (a great sugar manufacturer). These gentlemen reported on the liquids which were submitted to their judgment, considered by the manufacturer as residues, and by the Belgian government as fermenting liquors. They, however, refused to accept any remuneration for their reports. It must be known that scientific men in France generally hold it below their dignity to accept the part of witnesses, or to give certificates, for money, public opinion differing in this respect entirely from what is generally accepted in England; and I must say that science, and the respect due to science, do not suffer here from the maintenance of this point of professional ethics. M. Claes, insisting upon paying for the trouble he had caused, thoughtfully made over to the Société des Amis des Sciences those sums which it had been his intention to offer to his generous defenders.

Another gift, of 4900 francs, presented by Madame Huguard, becomes likewise interesting from attending circumstances. Left poor by the death of her husband, this lady and her daughter were partly supported by the society until an inheritance allowed her to dispense with support, to become in her turn the supporter of others, and to restore the sums which she had formerly received.

Many of these details I gather from the report which the secretary, M. Félix Bondet, read before a well-attended meeting of ladies and gentlemen at the Sorbonne last Monday, the 29th of April. The remaining proceedings comprised a short allo-

cution by the chairman, Maréchal Vaillant, minister of the Imperial household; a very eloquent speech in memory of the late physicist, Professor Verdet, by M. Levistal, a mathematician and librarian of the Ecole Normale; and a lecture by M. Mascarel on the application of spectrum analysis to astronomy. We shall have to return to these subjects.

The meeting of the *delegates of the scientific societies of France*, although occupying five days, from April 23rd to 27th, may be dismissed in a few words. This meeting may be considered as a small attempt to reproduce under official guidance what the British Association and similar societies attempt freely and successfully in England and in Germany. All societies in provincial towns of France devoted to the study of historical and natural sciences are invited once a year to send delegates to Paris, to hold two general and several sectional meetings in the Sorbonne, to listen to a complimentary speech of the Minister of Public Instruction, and to witness the distribution of prizes or of titles to some of their members. M. Corrlogin, from Lille, thus received a gold medal for researches in agricultural chemistry, chiefly on the absorption of carbonic acid by plants. He is better known for having been the first to prepare the useful reagent, iodide of phosphorus.

The sectional meetings were taken up with papers, none of which can claim much attention, from chemists at least. Interesting discoveries are, of course, announced in one of the numerous journals published weekly or monthly, and are never kept back for annual meetings such as these. The separation and the inferiority of the French country, which is almost completely drained by Paris, in a scientific point of view, becomes sadly evident by this reunion, which appears to be invented chiefly to give professors condemned to country life an opportunity of repairing to Paris once a year without asking for leave of absence.

Of all subjects touched upon we will only mention the disease of silkworms. M. Joly, professor of zoology at Toulouse, known through his controversy with M. Pasteur on spontaneous generation, pretends that nothing has as yet been discovered to explain or counteract this disease. This remark, directed, it seems, against his adversary, who is occupied with such researches, was controverted by the vice-president of the Agricultural Society of Lyons, M. Chaurard, and by M. Nicklès, who communicated the fact discovered by Liebig, that silkworms are the less liable to disease the richer the mulberry leaves are in nitrogen, and that Japan leaves contain much more of this element than those from Turkey.

As a proof of the seriousness of this subject, we mention that a petition against the sale of the eggs of the silkworms by government was reported upon at the sitting of the Senate on Saturday, the 27th of April. M. Dumas, who undertook the defence of the government, stated that important public works were undertaken in those parts where labourers were thrown out of work by the disease, and that M. Pasteur's researches, extending over many months, were promising a useful insight into the nature of the disease. Some details of these researches have been published.

At the last meeting of the *Académie:*

M. Pasteur, in a letter dated Alais, April 24, and addressed to M. Dumas, says that until now the corpuscles forming the cause of the disease of silkworms were considered by him as *organites;* this designation being applied to such organisms which, like the globules of the blood, the grains of starch, or spermatozoa, have no power of propagating their species. Lately, however, he has been able to discover that their mode of generation, like that of some infusoria (vibrio) consists in the division of one corpuscle into several others. He has also remarked in each parasitic globule a nucleus having the same oval shape as the former. He hopes soon to publish a more complete study of the disease.

M. Béchamp, in a note on the same subject, describes the same mode of generation, and claims for himself the priority of the discovery of the parasitic nature of the disease.

M. Becquerel publishes a long disquisition on the causes of rain. General Morin, on presenting the copy of a report of an Imperial commission on schools of art and industry, states that it is intended to increase the number of such schools for the benefit of the working-classes, and that a bill for the purpose will shortly be examined by the Corps Législatif.

Dr. Sterry Hunt continues his geological communications on magnesian rocks. The chief point of chemical interest in this note is the observation that silicate of sodium precipitates from mixed solutions of magnesium and calcium salts, first, silicate of magnesium, and then silicate of calcium, while carbonates follow the opposite sequence.

M. Coupvent des Bois, from observations made in 1838 and 1839 (partly by Captain Ross), calculates the *southern magnetic pole* as follows:

Latitude	72° ¾ S.
Longitude	135° E.

M. Dumas presents to the Académie the excellent manual *Principes de Chimie, fondée sur les théories modernes*, by Naquet. While the results obtained are faithfully reflected in this manual, M. Dumas would wish the methods of chemistry to be more fully developed in public instruction than M. Naquet seems to think proper. M. Dumas promises to revert to this subject. The want he complains of is evidently caused by the astounding increase of chemical observations, which forces the teacher more and more to generalise and to neglect details.

M. Cailletet calls attention to his easy process of amalgamating by the aid of sodium-amalgam. Half a per cent. of sodium is added to mercury, which is then moistened with very little water. Most metals, even iron, are easily amalgamated when plunged into this bath, and consequently gilding becomes greatly facilitated thereby.

M. Dusart states that disulphonaphthalate of potassium, when fused with potash, engenders the diatomic naphthylic phenol $C_{20}H_8O_4$ (old atomic weights). He describes this compound as crystallis-

ing in the rhombohedral system, and proves his assertion by analysis.

M. Kolb, in a note on the absorption of carbonic acid by oxides, states that the presence of moisture is required to effect such absorption by lime and by baryta.

M. Déhéran publishes the first part of his researches on potassic manures. I defer a report thereon until completion, being forced to conclude this letter, which, whatever may be the judgment of the reader, will, I am sure, be particularly welcome to the compositor, as he will find in it but few formulæ to bewilder him. There is a natural antagonism between printers and chemists, from which the reader of course suffers. I am obliged, therefore, to correct some of the most disturbing errors, while, in justice to the printing-office, I bear witness to their comparative scarcity. The hydriodic acid that M. Berthelot found too weak was of 1·7 specific gravity.* Cyanogen is converted by this reagent into hydride of ethyl, etc, but the latter is not acted upon. I did not say M. Després gave *us* proof, but "*no* proof," etc.† Let some other slight mistakes be covered with the veil of charity.

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *May* 6.

ONE of the most interesting displays in the chemical portion of the British side is that contributed by the British Seaweed Company, illustrating the patented process of Mr. E. C. Stanford, for extracting iodine, bromine, and other valuable products from seaweed, by destructive distillation. Mr. Stanford's method is based on the fact that by the ordinary incinerating process more than half the iodine is volatilised and lost, whereas by distilling the dried weed in suitable retorts the whole of the iodine is recovered. Not only is this great saving effected, but the seaweed so treated yields other products of great value, such as hydrocarbons of various densities, naphtha, ammonia, acetic acid, and illuminating gas; indeed, the works at head-quarters are lighted with the latter product. The charcoal left in the retorts is found, after lixiviation, to be of great value as a disinfectant and deodoriser, and the pitch is also useful, so that from beginning to end the process does not yield a single waste product. The specimens exhibited are arranged in their natural order, beginning with tangle (*laminaria*), bardarric (*laminaria*), and black wrack (*fucus*), in their natural condition. We then have them in the dried and compressed state, side by side with the charred weeds. The tangle char contains 40 per cent. of saline matter, bardarric char 35 per cent., and black wrack char 25 per cent. It would have been interesting to have added the average amount of iodine yielded by each description of weed. We next have these chars after lixiviation, each being suitable in that condition for a special purpose. Thus, the tangle char is the best for deodorising purposes, the bardarric char for making blacking, and the black wrack char for sugar refining. Following them come the hydrocarbons, of different specific gravities, from ·821 to ·911. There is also a peculiar liquid alkaloïd and an acid that deserve close investigation. The salts obtained by this process are the chloride, iodide, sulphate, and nitrate of potassium, and the sulphite and sulphate of sodium. There are also exhibited phospho-manure, carbonate of magnesium, calcined magnesia, and bromide of potassium. The tar is extensively used for sheep. The deodorising and decolourising properties of the tangle char are exhibited by means of two specimens of town sewage, one of which is a good imitation of ink, while the other, which has been submitted to its action, is as clear as ordinary water. The iodine and bromine appear to be good commercial qualities of those elements. In 1862 Mr. Stanford's process merely existed in his laboratory; at the present time it is being carried on on a large and prosperous footing at North Uist, one of the islands on the west coast of Scotland.

There is a good display of colours and varnishes, although we miss the names of our principal fine colour makers in the list; many of them, however, exhibit in the artists' colour class. John Hare and Co., of Bristol, show a good collection of the chrome yellows and greens, for which their house has so long been famous. In Messrs. Johnson and Matthey's show is also a good series of chrome colours, prepared from certain waste products by a secret process. They are particularly adapted for printing and lithography, and can be supplied at a very low rate. Hosegood and Co. have a splendid collection, displayed in the most perfect manner. The colours are piled, in the rough state, on cups made of opal glass, the whole being backed with black velvet; the double contrast between any particular colour and white or black can consequently be readily seen. This peculiar method of exhibition is the idea of Mr. Hosegood, the head of the firm, who is not only a clever chemist, but a man of artistic taste as well. The Paris, Chinese, and pure blues exhibited by this house are exceedingly fine; the chromes also will earn the admiration of every lover of colours. The same praise may be bestowed on their Dutch pink, their emerald green, which is particularly bright and pure, a pretty specimen of English brown, the tone of which is as bright and clear as the emerald green, and a superb sample of carmine. Their permanent yellow and Persian red are also very beautiful. Messrs. Wilkinson, Heywood, and Co.'s collection is another charming mass of colour. This firm has endeavoured to show several series of colours, but they have been unfortunately frustrated in their good intentions by a blunder of Messrs. Mazaroz, in making their case too small and their neighbour's too large. The curtailed series they do show are splendid specimens of what can be effected by carrying on scientific manufactures on scientific principles. The series of chromes, from scarlet to the palest primrose, are very beautiful.

* See p. 77. † P. 47.

The emerald greens are also very fine. A series of new greens, varying from a dark rich to a cool sage, are most interesting examples of what may be done by using iron as a basis—a remark that applies equally to a few new iron browns. Messrs. Wilkinsons have not been so fortunate in the arrangement of their case as Messrs. Hosegood, having used white as a background to their colours. With all due submission to them, we think also that the looking-glass back and side to the case does more harm than good, by throwing a greenish tint over the whole. This may be readily seen by examining the reflections of the various colours on the glass. The series of vermilions, for instance, is quite spoiled by this defect. Messrs. Talbot and Alder show some good lakes, emerald greens, and quaker greens, but it is most difficult to judge of them, owing to their being covered with the dust which the contractors' bad workmanship has allowed to enter their case. It may be mentioned *en passant* that the exhibitors generally are suffering from this plague of dust, which has been inflicted on them by the French Commission laying a close floor instead of leaving spaces between the boards. As none of Messrs. Mazaroz's cases fit with even an approach to accuracy, the exhibitors in Class 44 have been obliged to paper up the cracks left by the workmen. It may be readily imagined that exhibitors who require to open their cases continually for the examination or distribution of specimens find this constant use of the paste-brush a perfect nuisance. Messrs. Denton and Jutsum exhibit a good collection of lakes and a magnificent mass of carmine. Their bright brown is also very fine. Messrs. Ash and Co. exhibit a few colours of pure quality. Messrs. Forster and Gregory show a few colours for india rubber. They are probably made upon a zinc and iron basis. Mr. Alderman Rose exhibits colours, but we were until now unaware that his house manufactured these articles. The only exhibitor of colours for painting on china is Mr. John Bailey, who fully sustains his well-earned reputation. Mr. Pulford shows some colours which he calls "magnetic," we presume because they have an iron basis. Messrs. Mason, of Derby, show a good collection of umbers, ochres, and Venetian red. Mr. Calley's series of iron paints, running through a number of tints of brown, red, yellow, slate, and even blue and green, show how much may be done with this metal. This concludes the British show of colours, which, taken as a whole, are extremely fine. The productions of Messrs. Wilkinsons, Hosegood, and Denton and Jutsum are of a quality that seems only attainable by the greatest care and precision, united with scientific knowledge, and will hold their own against the best specimens shown by other countries; in fact, it may be said with perfect justice that they are amongst the strongest points of the English chemical display.

Books Received.—'Ure's Dictionary of Arts, Manufactures, and Mines.' Edited by Robert Hunt, F.R.S., 3 vols. Sixth Edition (Longmans). 'A Dictionary of Science, Literature, and Art.' Edited by W. T. Brande, D.C.L., F.R.S., etc., and the Rev. George W. Cox, M.A., 3 vols. (Longmans).

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

Influence of a Current of Gas on the Decomposition of Bodies. By D. Gernez.*

In studying the disengagement of gases from supersaturated solutions, the author observed that a layer of gas condensed on the surface of a solid which has been exposed to the air, gives rise to the decomposition of oxygenated water, and that the same effect is produced by a current of air. The following experiments show that similar effects are produced in other cases.

A solution of acid carbonate of calcium or barium, through which a current of any inactive gas, such as nitrogen, hydrogen, or atmospheric air, is passed, gives off carbonic dioxide and deposits neutral carbonate of barium or calcium; the action is, indeed, the same as that which takes place more slowly when the same solutions are exposed to the air. Acid carbonate of potassium, on the other hand, does not decompose on mere exposure to the air; but when a stream of air is passed through the solution it gives off, even at 10°, a continually increasing quantity of carbonic dioxide.

Similar results are obtained with the sulphydrates of alkali-metals, and with acid sulphites and acetates, which are reduced to neutral salts under the influence of an inert gas. Nitrates also, heated in a current of air (free from carbonic dioxide), are reduced to nitrites at temperatures much lower than those which are commonly regarded as essential to their decomposition. Nitrate of magnesium, thus treated, is reduced to a basic salt at 150°. Similar effects are likewise observed when a current of dry air or other inert gas is passed through nitric acid, hydrochloric acid, etc., maintained at a constant temperature.

In general, saline compounds, either in solution or in a state of fusion by heat, give up to an inert gas a definite quantity of such of their elements as are volatile at the temperature of the experiment.

Action of Heat on Iodhydric Acid. By P. Hautefeuille.†

Iodhydric acid decomposes at temperatures easily accessible to thermometric observation, but the results due to the action of heat alone are considerably modified by the action of the glass-tube. The acid, when progressively heated, begins to exhibit a violet tint in a thickness of 10 centimètres at about 180°; the coloration increases slowly up to 440°; and from that point to about 700° the proportion of the dissociated gases, measured by the volume of free hydrogen present, increases rapidly. This proportion varies also with the extent of heated surface; thus, when a stream of iodhydric gas was passed under the atmospheric pressure, through a tube filled with coarsely pounded glass, the proportion of the dissociated gases

* 'Comptes rendus,' lxiv, 606 (18 Mars, 1867).
† Ibid., lxiv, 608 (18 Mars, 1867).

was 2·6 p.c. at 440°, and 34 p.c. at 700°. If, instead of increasing the surface, a limited volume of iodhydric acid gas be heated in a sealed tube, the numerical results exhibit considerable irregularities, due to the action of the glass.

Platinum-black greatly facilitates the dissociation of iodhydric acid, enabling it to take place at a lower temperature, although, on the other hand, platinum in this finely divided state possesses the power of inducing the combination of iodine and hydrogen.

Iodhydric acid may be produced by burning a mixture of iodine-vapour, hydrogen, and detonating gas.

On Iodide of Silver. *By* H. Deville.*

Iodhydric acid, especially when concentrated and slightly warmed, dissolves silver rapidly, with evolution of hydrogen, forming crystallisable hydro-argentic iodide, AgI.HI; and on placing the solution of this acid salt in contact with silver foil, or leaving it exposed to the air, whereby the iodhydric acid is gradually oxidised, argentic iodide, AgI, is easily obtained in large beautiful crystals, having the same forms as the native iodide, viz. (according to Des Cloizeaux) a regular hexagonal prism with six-sided summits, cleaving very distinctly parallel to the base.

Argentic iodide may also be produced by pouring strong iodhydric acid upon argentic chloride, which is then immediately decomposed, with a hissing noise like that produced in the slaking of lime. The argentic iodide thus obtained may be dissolved in excess of iodhydric acid and converted into the crystallised salt as before.

When fused argentic iodide is placed in contact with a globule of mercury and an electrolyte, such as chlorhydric acid or iodide of potassium, the mercury is gradually converted into an amalgam containing a considerable quantity of silver.

When, on the other hand, a solution of mercuric iodide in iodide of potassium is enclosed together with silver-foil in a sealed tube, heated to 100° every day, and then left to cool, a considerable quantity of argentic iodide is gradually obtained in hexagonal crystals, then silver amalgam in its usual monometric forms, and lastly globules of argentiferous mercury.

Silver-foil introduced into vapour of mercuric iodide disappears rapidly as soon as it has attained the temperature of the vapour, and is converted, with evolution of heat, into argentic iodide, while mercury condenses on the cold parts of the apparatus.

These reactions are in opposition, apparently, at least, to the ideas usually entertained respecting the affinities of silver, mercury, iodine, and iodhydric acid; and, moreover, the physical properties of argentic iodide, whether produced by one of the methods just described or in other ways, exhibit some remarkable anomalies. Thus, Fizeau has lately shown† that this compound, between the temperatures of — 10° and + 70°, has a negative coefficient of expansion, that is to say, it contracts when heated and expands when cooled, the numerical value of the coefficient increasing considerably as the temperature rises.

The specific gravity of precipitated argentic iodide is, according to Deville, 5·807, and that of the fused substance 5·67; that of the crystallised iodide was found in two specimens to be 5·544 and 5·470; according to Damour, it is 5·665. The amorphous iodide is therefore more dense than the fused, and the latter more dense than the crystallised substance.

The theoretical density D (the reciprocal of the atomic volume), calculated from the densities of the component elements, is—

$$D = \frac{(a + b)\, d\, d'}{a\, d' + b\, d}$$

in which a and b are the atomic weights of iodine and silver, d and d' their densities. Substituting the numerical values, we find $D = 6{\cdot}527$.

The contractions $C = 1 - \frac{D}{\Delta}$, obtained by replacing Δ successively by the density of amorphous, fused, and crystallised argentic iodide (taking Damour's value for the last mentioned), exhibit negative values, viz.—

For the amorphous iodide... $C = -\,0{\cdot}124$
For the fused iodide .... $C = -\,0{\cdot}145$
For the crystallised iodide . $C = -\,0{\cdot}148$

This result is in accordance with the negative expansion-coefficient of argentic iodide observed by Fizeau, inasmuch as the compound would expand in cooling down from the temperature developed by the combination.

* 'Comptes rendus,' lxiv, 323 (25 Février, 1867).
† Ibid., lxiv, 314.

On the Lower Carbonic Sulphides. *By* O. Loew.*

Compounds of carbon and sulphur are not only obtainable by the action of sodium-amalgam on the common sulphide, but also by the following essentially different method:—Acetic acid is mixed in a retort with from one to two equivalents of phosphoric sulphide. The neck of the retort is placed upwards and attached to a condenser; its contents are then heated to 140° by means of an oil-bath. After a considerable time all the thiacetic acid will have distilled away, and there will be found in the retort a red, viscous residue, which is to be treated first with water and next with dilute solution of soda. After having been thus washed the red mass is dried, powdered, and digested with carbonic disulphide in sealed tubes at 120°. On cooling, filtering, and evaporating the filtrate to dryness, the sesquisulphide is obtained which the author has previously described, only it contains a slight amount of impurity. What remains on the filter consists (according to one sulphur determination) of the sulphide C_4S. This body dissolves in sulphuric acid with a red colour on gentle heating; nitric acid, when warmed with it, produces a violent reaction.

The lower carbonic sulphides are all amorphous; they are produced by the action of phosphoric persulphide on various organic bodies, such as monochloracetic acid and oxalic ether. The action in these

* 'Zeit. Chem.,' 1867, 20.

cases is probably such as to convert the carbonyl of a given compound into sulphocarbonyl, which then quits the radicles which only contain hydrogen and carbon, and becomes the source of the new sulphides in question.

On the Amalgam of Thallium. *By* J. REGNAULD.*

Thallium belongs to the group of metals which unite directly with mercury without the intervention of any physical or chemical auxiliary; the combinanation is attended with evolution of heat, and the resulting amalgam is electro-negative with regard to thallium itself. The amalgam of thallium affords, therefore, a further instance of the law previously observed by the author with regard to potassium, sodium, and cadmium, viz. that when a metal combines with mercury its electro-chemical character is modified in a manner which may be predicted from the thermic phenomena accompanying the combination, the amalgam being electro-negative with regard to the pure metal whenever the amalgamation is attended with rise of temperature.

Thallium-salts are decomposed by zinc and cadmium, which set the thallium free.

Bessemer Steel containing Tungsten. By M. LE GUEN.†

By experiments on the large scale made at the Imphy Steel Works the author has shown—

1. That the Bessemer furnace may be employed for combining steel with tungsten. 2. That the loss of tungsten in this process, as shown by analysis, is about the same as that which is incurred in the older methods of making wolfram steel. 3. That ordinary grey pig-iron smelted with coke, having nothing of the character of steel, and often impure, may, by treatment with wolfram, be rendered capable of transforming into good steel the metal decarbonised by the converter. 4. That it is possible to obtain by this method masses of tungsten-steel of large dimensions.

VARIA.

The Town Council of Edinburgh, on Tuesday last, resolved to invite the British Association to hold the meeting of 1868 in Edinburgh. This year's meeting will be held at Dundee, under the presidency of the Duke of Buccleuch, and will commence on Wednesday, September 4.

At the General Monthly Meeting of the Royal Institution of Great Britain, held on Monday last, Henry Cosmo Bonsor, Esq., Colonel Charles Douglas, R.A., Frank Clarke Hills, Esq., and Arthur Thompson, Esq., were elected members. The meeting reelected Dr. Tyndall as Professor of Natural Philosophy, and Dr. Frankland as Professor of Chemistry.

At Oxford, the Professor of Mineralogy (Prof. Maskelyne) will commence a course of lectures *On the Silicates*, in the lecture-room of the Museum, on Tuesday, the 14th inst., at 2 p.m.

At the meeting of the Cambridge Philosophical Society on Monday next a communication will be made by the Dean of Ely *On Modern Musical Scales.*

According to the 'Athenæum,' the Government have revived the plans of the late Prince Consort for bringing our various learned societies together in Burlington House.

The 'Pall Mall Gazette' finds that scientific lecturing pays well in America. Professor Agassiz lately delivered a course of lectures under the auspices of the New York Association for the Advancement of Science on the Natural History of Brazil, for which he demanded and was paid 500 dollars each, or 3000 dollars for the course of six lectures. Taking the time he devoted to each lecture —that is to say, an average of one hour and forty minutes—it thus appears that he received five dollars a minute for every minute he spoke. It appears, however, that the association which engaged his services did not lose.

The following minute in reference to the visits of teachers to the Paris Exhibition has been recently passed by the Lords of the Committee of Council on Education:—"1. In accordance with the practice of the Science and Art Department at the International Exhibitions at Paris in 1855 and in London in 1862, My Lords consider it desirable to offer encouragement to the Masters teaching in Schools of Science and Art to visit the present International Exhibition at Paris, with the view of studying those objects which may be likely to benefit the instruction given in such schools. 2. Their Lordships, therefore, announce to the certificated masters now engaged in giving instruction in schools of science and art connected with the department, that they will pay to each such master or mistress visiting the Paris Exhibition the sum of £5 in aid of their expenses, and to each an additional sum of £2 for any report or any useful suggestions which any such teacher may make (in respect to his or her duties or teaching) derived from the study of the Exhibition, such report having first been published in any journal, local or otherwise, and afterwards approved by their Lordships. 3. And further, to each of the three best of such reports referring to instruction in Science and to each of the three best reports referring to Art, My Lords will give respectively the following prizes, in addition to the sum above named, namely,—for Science, for the best report, £20; for the second best report, £15, and for the third best report, £10, and the same sums respectively to the three best reports for Art."

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

Publications Received.—'Proceedings of the Manchester Literary and Philosophical Society,' Vol. vi, Nos. 11 to 15 inclusive. 'Le Moniteur Scientifique Quesneville,' 249.

MEETINGS FOR THE FORTHCOMING WEEK.

MAY.

Tuesday, 14. Royal Institution. 3 p.m.
Prof. W. A. Miller, *On Spectrum Analysis.*
Royal Medical and Chirurgical. 8·30 p.m.
Civil Engineers. 8 p.m.
Photographic Society. 8 p. m.
Pharmaceutical Society. 8.30 p.m.
Conversazione!.

Wednesday, 15. Society of Arts. 8 p.m.
W. Fothergill Cooke, Esq., *On New Mac for Cutting, Tunneling, Quarrying, and Facin Slate, Stone, and Marbles.*
Pharmaceutical Society. 12 noon.
General Annual Meeting.

Thursday, 16. Royal Society. 8.30 p.m.
Royal Institution. 3 p.m.
Prof. Huxley, *On Ethnology.*
Chemical Society. 8 p.m.
Royal Society Club. 6 p.m.

Friday, 17. Royal Institution. 8 p.m.
Prof. Odling, *On the Absorption of Gases Metals.*

Saturday, 18. Royal Institution. 3 p.m.
Prof. Huxley, *On Ethnology.*

* 'Comptes rendus,' lxiv, 611 (18 Mars, 1867).
† Ibid., lxiv, 619 (18 Mars, 1867).

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⁂ All Communications relating to the Editorial Department should be addressed to THE EDITOR, 4, Norman Terrace, Stockwell, London, S.; but all letters relating to Advertisements, Subscriptions, and General Business Arrangements, to the Publisher, JAMES FIRTH, 42a, Cannon Street, London, E.C.

A COURSE OF SIX LECTURES ON

COAL-GAS,

DELIVERED AT THE ROYAL INSTITUTION OF GREAT BRITAIN.

BY

EDWARD FRANKLAND, F.R.S., ETC.

LECTURE III.

Photometry — Mr. Sugg's apparatus—Different kinds of gas-burner—The bat's-wing, Leslie's, Sugg's, the Bengel, the single-jet and the fish-tail burner—Advantages of combining two jets in the fish-tail flame—Conditions of luminous combustion—Diminution of light by admixture of air with coal-gas—Erdmann's method of valuing gas—Illuminating power affected by the velocity with which the luminous hydrocarbons are driven through the flame—Scholl's "platinum perfecter"—Effect of atmospheric pressure on the gas-flame.

We have seen that the value of a gas-flame as a source of light may be determined very accurately by comparing its illuminating power with that of a standard light.* When the two lights are so disposed that the shadows cast by an opaque body are of equal depth, or when they are placed so as to illuminate equally the opposite sides of a translucent screen, the squares of the distances of the lights from the illuminated surfaces express their relative powers. The plan of comparing the lights by means of a translucent disc is the one almost universally adopted at the present time. On the table you have a complete set of the apparatus now used in Photometry. This beautiful series of instruments has been brought to perfection by Mr. Sugg, the gas engineer, to whom I am indebted for its exhibition on the present occasion. First, we have a metre for the accurate measurement of the gas to be consumed. From the metre the gas passes to this delicate governor, which keeps the pressure of the gas absolutely or almost absolutely uniform, so that the consumption at the burner will remain constant during the experiment. For hours and days together it will keep the flame at practically the same rate of consumption. From the governor the gas passes by a flexible tube to the burner. Then we have a delicate balance for weighing the standard candles, and determining accurately the amount of spermaceti consumed.

The apparatus is now at work. The metre contains within itself a little clock, by which time is measured upon the same dial which indicates the quantity of gas passing out. By means of the electric light I throw the image of this dial upon the screen. [The lecturer performed this experiment and the subsequent ones as he described them.] You will see the minute hand of the clock, and also the pointer which shows the number of cubic feet of gas consumed per hour, in observations of one minute or even the fraction of a minute duration. You will also observe the relative speed at which the indicators of time and volume move.

First, I will go through the process of measuring the intensity of the light. In this box, situated upon a small tramway, midway between the gas-burner at one end of the tramway and two candles fixed at the other end, we have one of the translucent discs of which I showed you a rough specimen in my last lecture. When I move the box, which has an opening at each end to admit the light freely from the two sources, I find presently that the transparency of the disc within it disappears. There are two mirrors so fixed at a slight angle that I can see both sides of the disc, and tell when this occurs. It is now about the point of equality. The room ought to be perfectly dark, and the walls to be either lined with black cloth or painted dead black, so as to prevent any reflection from the sides of the box, in order to make the experiment perfectly accurate; so that this is a somewhat crude experiment. Upon the slab of wood, or the tramway upon which the box travels by wheels, there is a scale which shows the number of standard candles to which the light of the gas is equal. The pointer which coincides with the position of the transparent disc, now stands at "6," which would indicate that the gaslight is giving the light of six candles; but we are burning two candles, in order to get the point of neutrality or equality more readily. Therefore the "6" represents, not six candles, but twelve; and supposing that the reading had been taken in a perfectly dark room such as I have described, the luminosity of our gas-flame would be exactly equal to the luminosity of twelve of those sperm candles.

This mode of ascertaining the equality of light between two sources of luminosity may be varied in different ways, and there are different contrivances adopted. Mr. Wheatstone has made an apparatus by which he ingeniously revolves a little globular mirror travelling upon a block of wood between the two lights. You see upon it an elliptical or circular image of each of the two lights, and you move this between the two lights until the two luminous circles are equal in intensity.

Having thus made ourselves acquainted with the mode of testing the light of a gas-flame, let us now return to the subject of combustion. We have already learned that the degree of luminosity of a gas-flame depends upon the amount and quality of the hydrocarbon vapours in the shell of combustion; and secondly, on the temperature to which they are exposed. These two conditions are secured in different degrees by the different kinds of burners employed in the consumption of gas. Here are several descriptions of burners. The one I hold in my hand is termed the "bat's-wing" burner, which consists of a slit cut in a nearly globular piece of steel; and here is a peculiar form of Argand burner, known as "Leslie's burner," which consists of a number of minute steel tubes, which meet at a slight inclination and produce a continuous circle of flame. The latter is always furnished with a glass chimney, to give a draught and prevent smoking. Here is another kind of Argand burner formed of steatite; it is the inven-

* See Lecture II, p. 36.

tion of Mr. Sugg, and, as gas engineers say, gives the greatest amount of light of any Argand burner constructed in this country. There is a burner used in France, called the Bengel burner, which gives a somewhat greater amount of light; but Mr. Sugg's burner gives an increase of light that would make a flame of gas consuming five cubic feet per hour, which we have seen would be equal to twelve candles with an ordinary burner, equal to thirteen and a half candles. The gas companies have not been slow to take advantage of this burner. They measure the luminosity of their gas by it, and, thus keeping within the requirements of the Act of Parliament, they supply us with gas which gives the luminosity of about one and a half candles less than the Act of Parliament intends. The first and primitive form of burner was a single-jet burner, as it was termed; of which I have got here a specimen. Formerly gas was burnt in this way, and jets were arranged to represent candles. Sometimes two or three jets were employed. This was the very worst mode that could be devised, because the gas rushes uninterruptedly into the air through the aperture, and this is peculiarly unfavorable for the production of a maximum illuminating effect. A gentleman in Manchester, whose name I have for the moment forgotten, and who has been almost forgotten in regard to this invention by the world, happened to be trying some experiments with two jets, and, partly by accident and partly by design, he brought them together, so that the one jet was thrown across the other, and he was astonished by the great increase of light obtained when he thus produced the flat flame such as we now get from the burner known as the "fish-tail" burner. No doubt he would have been better known had he patented his invention, but, having given it to the world freely, with the usual generosity extended to men who do such things, he has been forgotten. This constitutes the most common kind of burner. I have here a table which illustrates the advantage the gentleman in Manchester gained by combining the two jets. It is a comparative statement of the illuminating powers of the same jets burnt separately and in conjunction as a fish-tail flame:

Comparative Illuminating Power of Separate and Combined Jets.

Size of Jets.	Relative value per Cubic Foot of Gas. Separate.	Combined.
·067 inch	100	164
·083 „	100	190
·100 „	100	184

To understand the merits and defects of the different burners, and even to know how to use them, it is necessary to examine closely the influences which affect the two great conditions of illumination already mentioned, viz. first, the amount and quality of the heavy hydrocarbon vapours existing in the shell of combustion at any moment; and, secondly, the temperature to which these vapours are at the same time exposed. Now, first, the amount and probably the quality of the heavy hydrocarbon vapours to which we have attributed the luminosity of a gas-flame—the rate of consumption of the gas, we will assume, remaining constant in the experiment—depends, first, upon the access of atmospheric air to the flame; secondly, upon the velocity with which the hydrocarbon vapours are driven through the flame; and, thirdly, upon the pressure of the atmosphere, as measured by the barometer. The loss of light from the admixture of air with the gas has been determined by a set of experiments, the results of which are set forth in the following table:

Diminution of Light by Admixture of Air with Coal Gas.

Pure gas			100
Gas with	1	per cent. of air	94
„	2	„	89
„	3	„	82
„	4	„	74
„	5	„	67
„	6	„	56
„	7	„	47
„	8	„	42
„	9	„	36
„	10	„	33
„	15	„	20
„	20	„	7
„	30	„	2
„	40	„	0

The gas supplied to this institution is cannel gas, and therefore, in the experiments I am about to show you, we shall not get results quite in accordance with this table.

I have here, in a small holder, cannel gas mixed with 10 per cent. of atmospheric air. We convey it to a burner, and compare its flame with a flame of the gas which comes directly from the main, and then with a flame of cannel gas mixed with 40 per cent. of air. We find that the first flame is very dim compared with the second, and that the luminosity of the third is scarcely visible. If the experiments had been made with coal-gas, the luminosity would have disappeared altogether. The richer the gas, or the greater the luminosity, the more air may be mixed with it without extinguishing the light. Prof. Erdmann, of Leipsic, has devised a mode of estimating the value of gas by admitting known quantities of air to the flame till the luminosity is entirely destroyed, the amount of air required for the purpose indicating the illuminating power of the gas. This reduction of illuminating effect is not due exclusively to the oxygen contained in the air; if we burn cannel gas, which I have previously mixed with 8 per cent. of pure oxygen, the light is somewhat diminished, but there is still a brilliantly luminous flame; yet gas with 8 per cent. of oxygen contains as much oxygen as it does when mixed with 40 per cent. of atmospheric air. The diminution of luminosity is due, therefore, not alone to the admission of oxygen, but also to the cooling influence of the nitrogen. That is the great cause of the diminution of the temperature of the flame upon its admixture with atmospheric air. Of course, this admixture must occur in all flames, or combustion could not go on, and we must sacrifice something to it. But the access of atmospheric air

to the interior of the flame should be as small as possible consistently with the perfect combustion of the gas.

The different burners present very different amounts of area of surface to the air compared with the volume of the flame. The extent of the area of attack for the oxygen, the pressure of the gas and the velocity of the current of air and of the flame, are conditions of great importance. If, with a fish-tail burner, I burn an unusually large quantity of gas, instead of getting more than the usual quantity of light, I get less, because the gas rushes out of the burner with extreme velocity, and carries a great quantity of air with it.

The second condition—the velocity with which the luminous hydrocarbons are driven through the flame—must be perfectly obvious. These hydrocarbons should remain as long as possible in the flame, for the sooner they get through the flame the sooner they cease to be luminous. If I put a short chimney on this Leslie's burner, we get a considerable amount of light; but when I replace it by a longer chimney the flame is shortened, because the air and the gas rush through it much more rapidly, and we get a markedly less degree of luminosity.

If more gas be turned on we get the rate of consumption to which our chimney is exactly adapted; but, on the other hand, when I reduce the rapidity with which the gas rushes through the flame I get almost the same amount of light with no increase in the consumption of gas. The fish-tail burner owes its advantage to the same condition. By making the two streams of gas impinge upon each other their velocity is retarded, and the luminosity of the flame produced is thereby greatly increased. An important improvement of this kind in the fish-tail burner was made a few months ago by Mr. Scholl, a manufacturer of gas-fittings in London, to whom I am indebted for the apparatus to illustrate his ingenious contrivance. It is almost incredible how small a thing will sometimes affect the amount of light given by any burner. Instead of letting the two jets of gas impinge upon each other, I let them impinge upon a little plate of platinum. Their velocity is thus still further diminished, and the luminiferous hydrocarbons linger much longer before they reach the air. In Mr. Scholl's invention the piece of platinum that receives the two jets of the fish-tail flame is inserted in the top of a little copper tube which fits the top of the burner. The increase of light, as you perceive, is marvellous. I have found the increase of illuminating power to vary from 21 to 71½ per cent.; and Dr. Letheby states that he has observed an increase of 63 per cent. with this so-called "platinum perfecter." When I pass the same gas through a naphthaliser it becomes impregnated with hydrocarbon vapours in much larger quantity than the ordinary gas from the gas-works; and we get, probably, a luminosity of 26 or 30 candles, instead of about 20 candles, with a consumption of 5 cubic feet per hour. With the piece of platinum in the naphthalised gas we get a very brilliant flame, extending almost down to the burner itself. The same invention may be applied to the bat's-wing burner with a corresponding advantage, but not so successfully to the Argand.

I have mentioned that the third condition which influences the light of a gas-flame is the pressure of the atmosphere, as measured by the barometer. This was thought remarkable when first observed, but it ceases to be so when we remember the experiment of the combustion of arsenic gas in rarified oxygen. The diminution of light with the reduction of pressure may be experimentally shown with an ordinary gas-flame.

[The lecturer applied the air-pump to reduce the density of air in which a gas-flame was burning, and showed that, while the volume of flame was not diminished, its luminosity was greatly reduced, as the air was rarified.]

The following table gives the results of a series of experiments with a coal-gas flame made in this way:

Pressure of Air in Inches of Mercury.	Observed Illuminating Power.
30·2	100·0
28·2	91·4
26·2	80·6
24·2	73·0
22·2	61·4
20·2	47·8
18·2	37·4
16·2	29·4
14·2	19·8
12·2	12·5
10·2	3·6

Thus, by reducing the pressure of atmospheric air, though the amount of gas consumed remains the same, the light is almost entirely destroyed; and by increasing the pressure, though the amount of gas is decreased, the flame is greatly augmented. Starting with a luminosity of 100, we get down to 83·4 by reducing the height of the barometer 3 inches. This diminution of luminosity follows a fixed and definite law, the decrease of light being directly proportional to that of atmospheric pressure. Of 100 units of luminosity 5·1 are destroyed by each reduction of one mercurial inch of atmosphoric pressure. The chief cause of this want of light is the diminution of density of the hydrocarbon vapours in the flame.

There is another experiment in connection with this part of our subject which is necessary for its completion. We have here an ordinary spirit of wine flame, with no perceptible luminosity. We place it in the receiver of a condensing air-pump, and expose it to increased atmospheric pressure. With the pressure of two atmospheres the luminosity of the spirit-flame becomes very perceptible, and it rapidly increases as the pressure approaches three atmospheres. If the pressure be now decreased the light again diminishes. When hydrogen or coal-gas is burnt under increased pressure, we in like manner get increased luminosity.

Such is the philosophy of the alteration of luminous effect in flames burning under reduced or increased pressure.

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *May* 20.

THE Jury of Class 44 appears at last to have completed the arduous task of examining the largest and most interesting collection of chemical products ever displayed under one roof. The British delegate, Mr. Herbert McLeod, starts for London to-day, and most of the eminent foreign chemists have already returned to their laboratories. The awards are not yet published, but the high and mighty *employés* of the Imperial Commission state that they may be expected before the end of the month.

Most of our readers are doubtless aware that the cultivation of the chinchona plant has been carried on in various parts of British India for the last seven or eight years with an amount of success that has far exceeded the most sanguine hopes of its introducers. In the whole of the fine display to be found in the case of Messrs. Howards and Sons there are no more interesting objects than those few grains of quinine extracted by Mr. J. E. Howard from bark grown at Ootacamund, on the Neilgherries. It would be useless to insist on the value of quinine as a febrifuge, or the impossibility of our continuing to occupy our tropical possessions were the supply of this valuable medicament to cease or even become lessened. These few grains of alkaloïd are simply a guarantee of increased health and a diminished death-rate, not only in British India, but in all our tropical colonies. The cultivation of the chinchona plant will not merely benefit our own countrymen, but also the natives, who, owing to the liberality of the Indian Government, may have as many plants as they require for cultivation on their own little plots of land, so that the poorest villager may have his remedy against fever literally at his own hut-door. Private speculation has also stepped in, and chinchona cultivation is fast becoming the rage amongst planters in the neighbourhood of Ootacamund. The native rajahs, too, are beginning to perceive the value of this wonderful plant, and many of them have applied to the Government for cuttings and instructions how to grow them. The Indian Government appears to have acted throughout in the most liberal manner, and to have left no means untried to secure the widest possible distribution of chinchona plants.

It was in May, 1863, that the first specimens of Indian-grown bark were received in England. They were at once forwarded to Mr. J. E. Howard for examination and analysis. It is almost unnecessary to say that this gentleman has been of the greatest service to the Government in giving advice as to the proper species of chinchona to introduce, and the methods of cultivation calculated to produce the largest yield of alkaloïds. His extensive knowledge of botany, his skill as a chemist, to say nothing of his practical acquaintance with bark as a commercial product, have rendered his counsel simply invaluable.

The results of Mr. Howard's first investigations were most satisfactory. Although only 500 grains of bark were sent, he was enabled to prove that the constituents of bark grown in India and in South America were the same—viz. quinine, quinidine, chinchonine, and chinchonidine. Another satisfactory feature was that the percentage of alkaloïds was as high as in South American bark of good quality, although the sample experimented on was only two years old, and consequently comparatively immature. In the following October another box of specimens reached Mr. Howard. In addition to the barks, a large quantity of dried chinchona leaves was also sent, in order that their value as a source of quinine might be estimated. After careful examination and analysis Mr. Howard gives it as his opinion that the chinchona leaf will not yield quinine in sufficient quantities to render it worth while to pick and dry it. He adds, however, that he would be glad to experiment on a larger quantity of leaves than that sent to him before deciding upon the question positively. The dried leaves contained about 1·31 per cent. of hydrated alkaloïd, but the amount of quinine was extremely small. The alkaloïd in the leaves appears to exist in very close relationship with the green colouring matter, which, in some sort, seems to be analogous to indigo. Its ethereal solution has a peculiar effect on the rays of light, the reflected ray being almost of a blood-red colour, while the transmitted ray is green. Some red bark from branches eighteen months old yielded no less than 6 per cent. of rough alkaloïd, a large proportion of which seemed to be quinidine and chinchonidine. The rough alkaloïd gave on further purification 4·10 per cent., of quinine, quinidine, chinchonidine, and a small quantity, 0·9 per cent., of chinchonicine. The specimens of bark from the *chinchona Pahudiana* yielded an insignificant amount of alkaloïd.

The third remittance of bark was received by Mr. Howard in June, 1864, and its examination gave the most interesting results, and proved the correctness of Mr. Howard's opinion, that cultivation would improve the produce of at least one species of chinchona, viz. *chinchona succirubra*. The specimens of *chinchona succirubra* yielded 6 per cent. of *purified* alkaloïds, consisting of quinine 3·14, chinchonidine 2·06, chinchonine 0·80. It may be here mentioned that this large amount of alkaloïds may be greatly increased by covering the stem of the plant with moss, a discovery made by Mr. McIvor, the talented superintendent of the plantations of Ootacamund. This sample of bark also proved another fact—that February is the proper time of year for the bark harvest. The examination of another sample of red bark showed the necessity of allowing it to mature before gathering it. The first sample, that which yielded 6 per cent. of purified alkaloïd, was thirteen months older than the second sample, which only gave half as much; the additional thirteen months, consequently, just doubled its commercial value. An additional quantity of dried leaves was sent with this remittance, and carefully experimented upon by

Mr. Howard, who gives it as his opinion that the alkaloïds exist in the leaf in a transitional state, rapidly passing into the quinoidine of commerce under the influence of the oxygen of the air. The young shoots of the plant seem to contain the alkaloïds in a state of maturity midway between those of the leaves and bark.

In August, 1865, Mr. Howard received eight more specimens, which gave the following results:

Chinchona succirubra.

No. 1. Bark of 3 years and 9 months' growth, and thickened by the application of moss; crystallised sulphate 6 per cent., chinchonine 1·06 per cent.

No. 2. Renewed bark of 1 year and 5 months' growth, being reproduced on the portion of a stem the bark from which had yielded Dr. de Vry 8·409 per cent. of rough alkaloïd; crystallised sulphate 5 per cent., chinchonine 1·80 per cent.

No. 3. Renewed bark of 1 year's growth; crystallised sulphate 2·72 per cent., alkaloïds soluble in alcohol 7 per cent.

No. 4. Bark of 2 years and 5 months, *not* thickened by the application of moss; crystallised sulphate 2·43 per cent., chinchonine 0·60 per cent.

Chinchona Calisaya.

No. 5. Bark of 2 years and 5 months' growth; crystallised sulphate 0·70.

Chinchona Condaminea.

No. 6. Bark of 1 year and 7 months' growth; crystallised sulphate 0·90.

Chinchona micrantha.

No. 7. Bark of 2 years and 5 months' growth, thickened by the application of moss; crystallised sulphate 5·82 per cent.

No. 8. Bark of the same age, but not thickened by the application of moss; crystallised sulphate 1·26 per cent.

The two last sulphates appeared to be salts of quinidine, and to contain no quinine at all.

The fine white crystallised sulphate of quinine from No. 1 did not stand the test used in commerce to detect the presence of the other alkaloïds. It appeared to contain sulphate of chinchonidine, which is commercially, although not medicinally, a disadvantage. It is, of course, possible to separate the chinchonidine, but then the percentage of available alkaloïd is much reduced. This difficulty, as Mr. Howard acutely observes, must be looked steadily in the face, and either the medical profession must be persuaded into believing that chinchonidine is as efficacious as quinine—a fact of which our leading quinologists have but little doubt—or else the plant must be encouraged to produce as much quinine as possible. The latter way out of the difficulty may seem to some of our readers an improbable one, but the conditions under which the different alkaloïds are formed are becoming more and more known every day, and there seems room to hope that in future years we may be able to grow plants yielding either of the four principal alkaloïds at will. In any case the Government have issued large supplies of the sulphates of quinine, quinidine, chinchonine, and chinchonidine, to the various military hospitals throughout India, in order that their comparative therapeutic value may be decided upon. We sincerely hope that preconceived opinions will not be allowed to interfere with these most important experiments, and that the medical men of India will spare no pains to obtain a fair and candid result.

In No. 7 there is a singular instance of the effects of cultivation in altering the constituents of a plant. The specimens of *chinchona micrantha* yield scarcely any chinchonine and a large amount of quinidine, but the native bark from Huanaco produces largely and chiefly chinchonine. The effect, too, of Mr. McIvor's system of applying moss is very apparent. Singularly enough, too, the mossing seems to alter the relative quantities of alkaloïds as well as the gross amount, as will be seen from the following figures:

No. 7.	Crystallised sulphate . .	5·82
	Aricine	0·29
	Chinchonine	0·39
No. 8.	Crystallised sulphate . .	1·26
	Aricine	0·60
	Chinchonine	a trace.

There appears, too, to be a tendency in certain of the chinchonæ, besides *chinchona succirubra*, to produce chinchonidine under cultivation. It is singular that this alkaloïd, which seems to approach more closely to quinine in its properties than any of the others, should always appear to accompany it in more or less abundance.

With respect to the power of being able to govern the yield and proportion of alkaloïds, Mr. McIvor—whose talent and energy it is really difficult to praise too much—makes some very valuable observations in a report to the Government in November, 1865. He gives it as his opinion that quinine and the other alkaloïds are first produced in the leaves by the action of the light and air on the sap, that they combine with the quinovic acid contained in the sap, and in this condition are carried down and deposited in the bark, the most impure going to the liber; but as the liber becomes transformed into cellular tissue the mixture of the other three alkaloïds yields quinine, which remains in the bark. When it reaches the light and air a process of oxidation appears to begin, the result being red colouring matter and gum. From this it will be easily seen that oxidation and consequent waste may be stopped by excluding their causes—light and air. The leaves, then, appear to form the alkaloïd laboratory, and the cellular tissue of the bark the storehouse, the produce of quinine being increased as the mixed alkaloïds pass out of the liber. By proper cultivation and mossing Mr. McIvor gives it as his opinion that as much as 15 to 17 per cent. of alkaloïds may be obtained from the bark. The quantity of bark itself is greatly increased by this system of mossing, which, in addition to its other advantages, allows the bark to be continually removed and renewed.

It will be noticed that throughout the above article we have adopted Mr. J. E. Howard's method of spelling the word "chinchona" and its derivatives.

The word being derived from the patronymic of the Countess of Chinchon, the first patient who experienced the curative effects of Peruvian bark, it should certainly be spelt "chinchona" if there be anything in a name.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *May* 20.

Meeting of the Academy of Sciences of the 13th and of the Chemical Society of the 17th inst.—Illness of scientific men.

AT the meeting of the 13th inst. the ACADEMY received a report from M. Becquerel on *some new chemical effects produced by capillary action.* The author was led to make the following experiments. A very narrow longitudinal slit was produced in a tube, which was afterwards filled with a concentrated solution of nitrate of copper. This was then put into a test-tube filled with a concentrated solution of monosulphide of sodium (NaHS?), care being taken to fill both tubes to exactly the same height. Very soon a deposit took place in the slit, which became wider, so that at last the inner tube got broken. The deposit, when investigated, was found to consist, *not of sulphide of copper, but of metallic copper.* Metallic silver has been produced in a similar manner. The author reserves for a future communication the explanation of these unexpected phenomena.

M. Boussingault returns to a fact he discovered two years ago, viz. the destruction of the property of green leaves to decompose carbonic acid, by exposure to the influence of mercury. He now calls attention to a similar observation published in 1797 by four Dutch savants, who found that leaves placed in a bell-jar over mercury were soon covered with black spots, but were preserved from this influence when sulphur was placed in the bell-jar by the side of the leaves. The latter part of this observation has been made the subject of new experiments by M. Boussingault, who has been able fully to confirm the preserving influence of sulphur. The reason of this action he promises to explain in the second part of his researches.

M. Dehérain (not Dehéran, as printed in No. 6) gives the second part of his researches on *the application of potassic salts as manures,* a subject of great novelty and importance to agriculture.

We thus recapitulate the results communicated in this and his former note.

Owing to the cheap production of potassic salts at Alais from sea-water by M. Merle, and from the mines at Stassfurth, the farmer is supplied with potassic manures of the following composition, and at the following rates:

a. Merle's manure, $K_2Mg(SO_4)_2.6H_2O$, costing at Alais 14 francs, at Grignon (agricultural school, close to Versailles) 17 francs, per 100 kilogrammes.

b. Vorster and Grüneberg's Cologne-manure, of a complicated nature, containing clay, sulphate of lime, etc., together with 10 or 12 p.c. of potassa in the form of sulphate, costing at Cologne 8½ francs, at Grignon 13½ francs, per 100 kilogrammes.

c. Concentrated sulphate of potassa, containing 30 p.c. of potassa, 14 p.c. of soda, some common salt, and the sulphates of lime and magnesia, costing 37 and 42 francs at Cologne and at Grignon respectively.

These manures have been tried at Grignon on wheat, beetroot, and potatoes. Fields of five "*ares*" each have been provided with equal quantities of potassa contained in different quantities of the manures to be tried, and corresponding to double the quantities which an average crop takes out of the land. The results obtained have been compared throughout with the crops given by fields not treated with potassic manure.

Wheat.

Manure employed.	Quantity employed for one hectare.	Gain (+) or loss (—) produced in one hectare.
a	600 kilogr.	+ 40 francs.
b	800 "	+ 159 "
c	200 "	— 13 "
None	——	——

Beetroot.

Loss produced throughout varying from 175 to 256 francs per hectare.

Potatoes.

Manures employed.	Quantity per hectare.	Gain (+) or loss (—).
a, together with phospho-guano	1000 + 200 kilo.	+ 160 frcs.
b, " "	1500 + 200 "	+ 120 "
c, " "	600 + 200 "	— 114 "
Phospho-guano	200 "	——
a	1000 "	— 170 "
b	1500 "	— 106 "
c	600 "	— 304 "
None	——	——

The conclusions obtained are therefore favorable for wheat, unfavorable throughout for beetroot, and favorable for potatoes, if the potassic salts in the latter case are employed together with phospho-guano. They tell in favour of the use of complicated manures like *b*, and against the application of concentrated manures like *c*.

No difference could be remarked in the percentage of potassa contained in the ashes of wheat grown with or without the application of potassic manures. Beetroot grown without contained 21 parts of potassa in 100 parts of ashes; grown with the aid of phospho-guano only, it contained 31 p.c.; and with the application of potassic manure, the quantity of KHO found was between 21 and 32 p.c. The result obtained with potatoes is quite as indefinite.

No increase of sugar in beetroot or of starch in potatoes could be obtained by the application of potassic manures, but the crop of the latter and of wheat was, as we have seen above, considerably increased by this process. Sound potatoes contain 31·3 of potassa and 27·7 of soda in 100 parts of ashes, while diseased potatoes contain 24·5 KHO and 20·8 NaHO. But for all that, potassic manure did not decrease the proportion of diseased potatoes, this proportion having been found = 2·6 p.c. in manured

land and 2·1 p.c. in land not treated with potassic manures.

M. Chydenius* describes his *pseudo-hexylic urea*, mentioned at the last meeting of the Chemical Society. It forms fine white needles, becoming liquid at 127°, and distilling at 220° while undergoing partial decomposition. Its crystalline form and its stability when treated with potassa distinguish it from hexylic urea obtained from iodide of caproyle by Pelouze and Cahours. M. Chydenius, to obtain his compound, treated iodhydrate of hexyle (obtained from mannite according to MM. Wanklyn and Erlenmeyer's process) with cyanate of silver. The cyanate of hexylene attacks the eyes, and is easily transformed by ammonia into the urea:

$$\left.\begin{matrix} CO \\ (C_6H_{12}H)H \\ H_2 \end{matrix}\right\} N_2.$$

M. Grimaux describes *monobrominated and dibrominated gallic acids*—

$$C_6HBr\left\{\begin{matrix} CO_2H \\ (OH)_3 \end{matrix}\right., \text{ and}$$

$$C_6Br_2\left\{\begin{matrix} CO_2H, \\ (OH)_3 \end{matrix}\right.$$

obtained by treating in a mortar gallic acid with the corresponding quantities of bromine. They crystallise from aqueous solution, and take various colours (red, green, and orange) when exposed to the air and to the action of lime water. These colours are very changeable. Klasiwitz describes the same acids in the last number of the 'Annalen der Chemie.'

MM. Laugier, Guérin, and Nélaton, have put up as candidates to fill the vacancy in the Academy caused by the death of Jobert de Lamballe.

M. Hirn, author of a treatise on the mechanical equivalent of heat, has been proposed by the mechanical section to replace M. Delezenne (deceased) as correspondent of the Academy.

The Chemical Society held another meeting on the 17th inst. M. Debray in the chair.

M. Grimaux communicated his researches on *brominated gallic acids*, of which we have given an extract above.

The President then gave the following interesting details on metallic *glucinum*. The difficulties attending the preparation of this metal are considerably increased by the action it has on silicic acid. M. Menier has therefore made a decided progress, by substituting pure alumina crucibles for those hitherto employed, and by taking the double fluoride of glucinum and sodium instead of chloride of glucinum, which offers disadvantages to be mentioned hereafter. The double fluoride is then decomposed by sodium. Only small globules of the metal can be obtained, on account of its specific lightness (=2·0), which prevents the metal collecting at the bottom of the crucible. The metal is sufficiently malleable to be rolled out into ribbon. If there should be a fault in the metal, the sides of the lamina will have incisions; if these are cut off before the progress of lamination is proceeded with, a perfectly sound plate may be produced. It is to be hoped that by determining the specific heat of glucinum we shall soon know at last the atomic weight of this metal. If diatomic, as supposed, glucinum must have a very high specific heat, its equivalent being lower than that of any other metal, only 4·7. Chloride of glucinum is volatile at a high temperature. To take its vapour-density, therefore, Deville's porcelain vessels with very narrow necks, would have to be used. But as the chloride is extremely deliquescent, it cannot be introduced into the vessel without absorbing water. It is for this reason that until now the vapour-density has not been determined.

M. Lauth followed by communicating a paper on the aniline colour discovered by him, and known under the name of "Violet de Paris." Some controversy having been caused through this discovery as to the identity of this and Hofmann's violet, and as to the priority and legality of the manufacture of M. Lauth's colour, this paper excited considerable interest. The author having conceded to our request of sending a full report on the subject to the Editor of this Journal, we refrain from entering into an analysis of the same.*

At the Palais Royal Club last Monday, Dr. Hugo Tromsdorff exhibited perfectly pure salts of erbium, didymium, lanthanum, caesium, rubidium, etc. They were submitted to spectroscopic examination, when only those lines which correspond to the pure substances appeared in the spectrum. Nothing could prove more fully that carefulness which has always been the chief feature of Herr Tromsdorff's manufactory. Of English chemists present at the meeting of the club we may mention Dr. Price, Mr. Nicholson, and Mr. McLeod.

The numerous friends of M. Pelouze, Director of the Mint, are grieved to learn that the disease from which this eminent chemist has long been suffering, and which, during the last few weeks, had taken a turn for the better, has again increased. M. Pelouze is, unfortunately, not the only savant whose work is at present interrupted through illness. M. Persoz, of the Conservatoire des Arts, M. Claude Bernard and M. Longet, the celebrated physiologists, have all for months been prevented, through illness, from giving their lectures and from following their professional scientific pursuits.

ROYAL INSTITUTION.

On Friday, the 17th instant, Prof. Odling discoursed before a large audience on Mr. Graham's recent researches *On the Absorption of Gases by Metals*. We hope to give a full abstract of this interesting lecture in our next. On Tuesday last Prof. W. A. Miller gave his second lecture *On Spectrum Analysis*, and delighted all present by his exhibition of the glorious spectrum of the new metal, indium. We shall have to return to this lecture.

* Not *Chyderius*, as printed in the last number of the Laboratory. We also correct the following misprints of names:—Read Alexieff, Jaworsky, and Ladenburg, instead of Alexioff, Taworsky, and Laderburg.

* See present number, p. 138.

CHEMICAL SOCIETY.

THURSDAY, MAY 16.

Professor F. A. Abel, F.R.S., Vice-President, in the chair.

The minutes of the previous meeting having been read and confirmed, Mr. F. W. Peterson signed the Statute-book, and was admitted a Fellow of the Society. The list of donations to the Society was then read and thanks returned to the donors.

The names read for the second time were, Augustus Alfred Wood, William Phipson Beale, and Alfred Coleman. Those gentlemen whose names had been read for the second time at the last meeting of the Society, May 2, were not balloted for at this meeting.

The Chairman having announced that Mr. Perkin had an interesting communication to make to the Society on some salicyl derivatives—

Mr. W. H. Perkin said that there appeared to be an intimate relation between coumarin and the salicyl compounds, as salicylic acid was found amongst the products of its decomposition. Coumarin was first discovered by Delalande in the tonquin bean, and the formula since assigned to it was $C_9H_6O_2$. This, when gently heated with strong potash, assimilated an equivalent of water and formed coumaric acid, $C_9H_8O_3$; but when coumarin was fused with potassic hydrate it split into salicylic and acetic acids:

$$\underset{\text{Coumaric acid.}}{C_9H_8O_3} + 2KHO = \underset{\text{Potassic salicylate.}}{C_7H_5KO_3} + \underset{\text{Potassic acetate.}}{C_2H_3KO_2} + H_2$$

By acting upon the sodium compound of hydride of salicyl by acetic anhydride, he had obtained a body which was apparently identical with coumarin in all its properties, and which under the influence of fused potassic hydrate spilt into salicylic and acetic acids. In a short time he hoped to be able to lay before the Society a paper containing a detailed account of his experiments.

Professor Abel thanked the speaker for bringing forward such an interesting instance of the synthetical production of an organic compond.

The Secretary then read a paper by Professor Rammelsberg, of Berlin, *On the Constitution of the Phosphites.*

The author first gave a short historical account of the researches on the phosphites. Sir H. Davy, in 1812, published an account of several phosphites. Berzelius afterwards showed that many phosphites contain water which cannot be expelled by heat. Ten years later H. Rose published the results of his analyses of the phosphites, in which he confirmed the results of Berzelius, that phosphites contained, chemically combined water, but that the proportion was not the same for all salts, as some, like the baric, calcic, and strontic compounds, contained two equivalents of water, while the others, as the phosphites of zinc and manganese, contained only one equivalent. In 1842 and 1845 M. Wurtz gave an account of his researches on the hypophosphites and phosphites, and from the results of his analyses of members of the latter class of salts he inferred that the formula of phosphorous acid was H_3PO_3, and of the phosphites HR_2PO_3 and $HR''PO_3$, thus assigning to all the phosphites but one atom of hydrogen, not displaceable by metals, whilst Berzelius and Rose found some of them to contain two atoms. The author had prepared and analysed many of the phosphites of which the paper contained the results.

The first salt described was phosphite of barium, which was prepared by dissolving terchloride of phosphorus in water, adding chloride of barium and then ammonia, taking care that the liquid still retained a slightly acid reaction. The white precipitate dried in air lost a small quantity of water at 250°, and then gave 60·89 p.c. of barium, corresponding to the formula $H_4Ba''_2P_2O_7$. When treated with nitric acid, phosphites are converted into pyrophosphates. The barium compound, when thus treated, gave a residue insoluble in hydrochloric acid, which, when heated, fused into a vitreous mass of metaphosphate. From this the author concluded that nitric acid converts phosphite of barium into pyro- and metaphosphate and nitrate. When heated, baric phosphite gave off H_4, and the residue, on digestion with sodic sulphate, gave a solution which, with argentic nitrate, precipitated pyrophosphate of silver. The strontic and calcic salts were prepared in a similar manner, and when heated lost their hydrogen with incandescence, a small quantity of phosphorus and phosphoretted hydrogen being liberated by a secondary decomposition. The formula for the salts dried in air was found to be respectively $H_4Sr''_2P_2O_7 + 2H_2O$ and $H_4Ca''_2P_2O_7 + 2H_2O$. The magnesic compound was prepared by dissolving magnesia, either in pure phosphorous acid or in a solution of terchloride of phosphorus, and then adding sufficient sodic carbonate to nearly neutralise the solution. It existed in different states of hydration, according to the circumstances under which it was obtained. Precipitated from a very dilute cold solution, it was crystalline, and contained $12H_2O$, seven of which it lost in dry air, and the rest at 100°, when it had the composition $H_4Mg''P_2O_7$. When strongly heated it presented the same phenomenon of glowing as the calcic compound, and the white residue of pyrophosphate became yellow on cooling. The nickel salt was prepared in a similar manner to the magnesium compound, and the pale green powder thus obtained was found to contain $H_4Ni_2P_2O_7 + 6H_2O$. Three H_2O were removed by drying over sulphuric acid. Cobaltic phosphite, when first precipitated, was red, but by heating to 250° it became blue, and then contained $2H_2O$; when more strongly heated it became incandescent and left a residue of phosphate of cobalt. Considerable difficulty was found on the analysis of the cobalt and nickel compounds, as neither treatment with alkaline sulphides nor fusion with alkaline carbonates completely decomposed them. Phosphite of manganese was reddish-white, and dried at 200°—250°, had the composition $HMnPO_3$; when more strongly heated it gave off hydrogen with incandescence, and left a residue of phosphate and phosphide of manganese. Two zinc salts were obtained, one having the composition $HZnPO_3$, and the other $HZnPO_7$. The cupric salt was blue,

and had the composition $HCuPO_3 + 2H_2O$. At 130° it began to decompose. The ferric salt was obtained by nearly neutralising a solution of terchloride of phosphorus in water, and precipitating by iron alum. This phosphite was found to be $H_3FeP_3O_9 + 3H_2O$.

According to the views of Berzelius and Rose, there were two series of salts, the first having the composition $HR''PO_3$, like the phosphites of copper and zinc, the second $H_4R''_2P_2O_7$, as $H_4Ba''_2P_2O_7$; $H_4Ca''_2PO_7$. From the fact that the hydrogen in these compounds was not displaceable by a metal, and from the composition of the two zinc salts and the magnesic salts, the author concluded that the hydrogen present in the phosphites must be regarded as hydrogen of constitution, and not as water, in the same way as the hydrogen in H_2SO_4 and HKO was considered to be a part of the sulphuric and potassic hydrates, and not present as water. Phosphorous acid had the composition $H_4P_2O_5$, and the crystallised acid was $H_4P_2O_5.H_2O$. The H_2O of the latter could not be separated by heat, as phosphuretted hydrogen was produced.

Professor Abel having expressed the thanks of the meeting to the author for his very interesting paper on the phosphites—

Dr. Gladstone remarked that for his part he preferred the more simple formula, H_3PO_3, for phosphorous acid, as when terchloride of phosphorus was treated with water the three equivalents of chlorine were replaced by hydroxyl, thus—

$$PCl_3 + 3H.HO = P(HO)_3 + 3HCl.$$

This gave the formula H_3PO_3 for phosphorous acid, whilst to obtain the formula $H_4P_2O_5$, preferred by Professor Rammelsberg, it was necessary to suppose the following reaction to take place:

$$\begin{matrix}PCl_3\\PCl_3\end{matrix} + \left.\begin{matrix}H\\H\end{matrix}\right\}O = \begin{matrix}HCl\\HCl\end{matrix} + \left.\begin{matrix}PCl_2\\PCl_2\end{matrix}\right\}O,$$ which latter body was then decomposed by $4H_2O$, giving 4HCl and $\left.\begin{matrix}P(HO)_2\\P(HO)_2\end{matrix}\right\}O = H_4P_2O_5$.

A paper by Dr. Dupré, *On the Changes in the Proportion of Acid and Sugar during the Ripening of Fruit*,* was then read by the Secretary.

It was a well-known fact that as fruit ripened the percentage of acid decreased, whilst that of sugar increased, but as the fruit at the same time became heavier it did not necessarily follow that the acid was converted into sugar, as the total weight of acid in the ripe fruit might be nearly equal to that in the unripe fruit, although the percentage was much less. In order to ascertain if this were the case the author had made some determinations of the quanty of free and combined acid in samples of grapes gathered in different stages of ripeness. Three samples of grapes, gathered on Sept. 13, Oct. 12, and Nov. 16, gave respectively 2·8 p.c., 1·7 p.c., and 1·5 p.c. tartaric acid; 100 average-sized grapes, at the same dates, gave respectively 2·5 grms., 1·9 grms., and 1·8 grms. tartaric acid. The analyses of other samples of grapes were given, which agreed with the one quoted in showing that there was but very little diminution in the total weight of acid during ripening. This tended to prove that the acid of fruits was not converted into sugar during the ripening, but it might act in the production of sugar in the same way as dilute acids convert starch into sugar.

Professor Abel remarked that more data were necessary before a decided opinion could be given of the action of acids during the ripening of fruit.

Another paper, also by Dr. Dupré, *On the Addition of Plaster of Paris to Must*, was then read.

The author said that it was a common practice in Spain, Portugal, and the South of France, to add plaster of Paris to the grape-juice, either before pressing or after fermentation had set in, the reason assigned being that it removed water and made the juice richer in sugar. It was true that plaster combined with one fourth its weight of water and absorbed about its own weight of fluid, and that probably the loss by absorption of must would be greater than the gain in richness. In order to determine this, 48 oz. of Lisbon grapes were expressed, and gave 32 oz. of juice. To three portions of this juice, 10, 20, and 50 per cent. respectively of plaster were added, and after being allowed to stand twenty-four hours the juice was expressed and found to be 90 per cent., 80 per cent., and 43 per cent., of the original quantity of juice. On examining the quantity of acid present before and after treatment with plaster, it was found that much of the tartaric acid was removed, and the potassic tartrate present was converted into the corresponding sulphate. The effect of the addition of plaster, therefore, appeared to be injurious, as the free calcic carbonate removed a portion of the tartaric acid, whilst the potassic tartrate was converted into sulphate by double decomposition with the calcic sulphate of the plaster, the malic acid remaining undiminished, so that the tendency was to increase the proportion of malic acid, thus making the juice more like that from unripe fruit.

Dr. Odling remarked that the custom was universal in Spain and Portugal, and therefore we must not be too hasty in condemning it. If a solution of baric chloride were added to a glass of sherry a copious precipitate of baric sulphate was formed.

The Secretary then read a short account of *An Adapter to absorb Sulphuretted Hydrogen*, by the Rev. B. W. Gibsone.

His object was to collect the excess of sulphuretted hydrogen wasted in the ordinary analytical operations, and convert it into a useful laboratory reagent. The whole apparatus consisted of three parts—1, a generator, which he had already described; 2, an absorber, consisting of a series of three Woulfe's bottles partly filled with caustic ammonia; and 3, the adapter. This consisted of a funnel, around the neck and lower part of the cone of which caoutchouc was fastened, so that it would fit any vessel. To the mouth of the funnel a vulcanised cap was adapted, having three openings, one of which was ordinarily stopped, another served as a means of exit for the excess of sulphuretted hydrogen, whilst the centre one was furnished with a piece of apparatus by which

* In the brief report given in our last, Dr. Dupré's communications were erroneously ascribed to Dr. Debus.

the gas could be passed either through the liquid contained in the vessel fastened to the adapter or directly to the exit tube.

Mr. W. C. Wright then read some extracts from a paper *On Practical Loss of Soda in the Alkali Manufacture*. The loss was but small in the conversion of salt into salt cake, the results of careful determinations giving only about 0·4 per cent., a portion of which is carried off mechanically by the hydrochloric acid. The residue left after the extraction of the black ash in the vats still contained some soda, which could not be extracted by lixiviation, either with hot or cold water, but was dissolved by long boiling. This appeared to be due to the lime present, as it was well known in causticising carbonate of soda by lime the carbonate of lime retained a considerable quantity of soda, which could not be extracted by washing. Considerable loss also arose from the absorption by the brickwork of the furnaces and in drying.

The Chairman having thanked the author, the meeting was adjourned to June 6, when Sir Benjamin Brodie is to deliver a lecture *On Ideal Chemistry*.

ORIGINAL COMMUNICATIONS.

M. LAUTH ON A NEW ANILINE VIOLET.

On the New Aniline Dye, "Violet de Paris." By CH. LAUTH.

ONE of the chemical curiosities of the Paris Exhibition is a block, weighing about 150 kilogrammes, of a fine golden-green colour, and consisting of a violet colouring matter, to which the exhibitors, Messrs. Poirrie and Chappat, have given the name "Violet de Paris." I propose to give you the history of this product.

In 1861 chemists had succeeded in producing from aniline only two tinctorial products (at present, as you are aware, their number is considerable). One of these, discovered by Mr. W. H. Perkin, and known as mauveine, is prepared by the action of potassic bichromate on the aqueous solution of an aniline salt; the other, called rosaniline, discovered by Dr. Hofmann, is produced by the action of powerful oxidising agents upon aniline, at a temperature of 180° C.

At the date above mentioned, when all manufacturing chemists were borne along by the tide of aniline research, and so many important discoveries were realised, it occurred to me to try the action of oxidising agents (especially nitrate of mercury), not only on aniline, but likewise on its alcoholic derivatives, methyl- and ethyl-aniline; and I observed that, under the conditions in which aniline yields red or mauve dyes, methyl-aniline produces violet and purple colours, whereas ethyl-aniline yields nothing but products having but little tinctorial value. The violets obtained from methyl-aniline possess a richness and purity which leave nothing to be desired; they are easily soluble in water, and exhibit all the characters of true colouring matters. Nevertheless they were not adopted by manufacturers, who, indeed, at the time above mentioned, attached less importance to the beauty of a colour than to its permanence. In this latter respect the methyl-aniline violets do not excel, and consequently dyers would have nothing to do with them.

Gradually, however, people have become accustomed to colours which fade on exposure to the solar rays. Indeed, the public taste at the present day, in colours as in everything else, inclines rather to tinsel than to solid excellence. Accordingly, two years after the experiments made by myself, Dr. Hofmann succeeded in introducing these violets, which he has baptised with his own name. The mode of preparation adopted by the eminent chemist of Berlin is the inverse of my process, the aniline being first oxidised, and the rosaniline thus obtained being transformed into methyl- or ethyl-rosaniline by the action of alcoholic iodides.

The success attained by Hofmann's violet leaves but one course to be pursued, namely, to retrace the path already opened. You are aware that in France, by virtue of a monopoly which has pressed heavily upon the industry of that country, the manufacture of rosaniline belongs exclusively to one house, all others being forbidden to meddle with it. Accordingly, M. Bardy, chemist to the house of Poirrie and Chappat, sought for and discovered a method of producing methyl-aniline on the manufacturing scale, and converting this alkaloïd economically into a colouring matter. Methyl-aniline is, in fact, easily produced by heating under pressure a mixture of aniline, chlorhydric acid, and methylic alcohol,* and its conversion into a colouring matter is effected by heating it with iodine and chlorate of potassium. In this manner the new colouring matter is obtained combined with iodhydric acid, and forming a salt insoluble in water. This salt is decomposed by soda, and the base thus liberated is transformed into a chlorhydrate by the direct action of chlorhydric acid.

Quite recently I have discovered another mode of preparing methyl-aniline violet, whereby I obtain a colouring matter soluble in water. It consists in decomposing certain salts of methyl-aniline, the chlorhydrate, for example, by heat. By raising the temperature to 100° or 120° C., a large quantity of colouring

* For this purpose strong cast-iron vessels with safety-valves are employed. According to the manufacturers, the pressure sometimes rises suddenly to 140 atmospheres.

matter is obtained at a very moderate cost. The same transformation may be equally well effected by the action of powerful oxidising agents, such as nitrate of copper, acetate of mercury, etc.

The *Violet de Paris* is a methyl-aniline violet. Its percentage composition is apparently the same as that of Hofmann's violet, but it is evident that the two products are only isomeric. In fact, Hofmann's violet consists of methylated or ethylated rosaniline, and rosaniline is derived from a molecule of aniline and two molecules of toluidine. The *Violet de Paris*, on the contrary, is produced from pure aniline, *free from toluidine*,* transformed into methyl-aniline, which is *isomeric with toluidine*. This methyl-aniline, when oxidised, is converted into the violet, which may have a composition analogous to that of methylated rosaniline, but must differ from the latter in the same manner as methyl-aniline differs from toluidine; and as long as we are unable to transform methyl-aniline into toluidine, so long may it be safely affirmed that the action of oxidising agents on methyl-aniline cannot give rise to any product derived from rosaniline.

EDITORIAL NOTES.

A CHEMICAL DIPLOMA.

NOTHING, perhaps, tends more to lower science in public estimation than the habit of associating it with something which does not command respect, though it may contribute to general amusement. All that most people know about chemistry is gathered from popular lectures and exhibitions, where they learn to connect it inseparably with little else than brilliant illuminations, offensive odours, loud explosions, and magical transformations. Though we may regret this result, we can hardly blame the caterers for public amusement; nor ought we to find fault with those who regard the combustion of phosphorus at a lecture, and that of nitrate of strontium in a pantomine with the same pleasurable emotions. But what we regret, and must censure heavily, is the assumption of scientific titles by mere public entertainers, or rather the recognition of that assumption by those who should know better, as well as the strange delusion which people seem to labour under, that while attending such exhibitions they are acquiring a knowledge of chemistry. Nor can we overlook the fact that lectures given by men of recognised position sometimes approach the "entertainment" style, the lecturer for the nonce assuming the manner of the showman, doubtless from a wish to make his subject popular as well as instructive, and to impress facts on the memory while appealing to the fancy. We think this is an error, and one which tends to the degradation of science rather than to the elevation of the minds of the hearers. The attempt to interest persons who wish to become learned without trouble in a subject which requires attention and thought, is unworthy of a scientific man. The power to simplify abstruse matters so as to adapt them to the understanding of those who seriously desire to gain knowledge constitutes the difference between a good and bad lecturer or teacher.

The quackery of pseudo-science and the gullibility of the public are evils with which we have to contend; that there is a remedy for the former, at least, we cannot doubt, and its application is in our own hands. The line of demarcation between real chemists and those who ape them cannot be too clearly defined, and there seems to be no better way of doing this than by examination tests. It may be argued that such safeguards are in existence already; that the degrees of the London and other universities guarantee a knowledge of chemical science. This is to a certain extent true, but it is not such a knowledge as would justify a man in claiming to be considered a chemist, except in the case of the degree of Doctor of Science of London, which, from its difficulty of attainment, is within the reach of but very few. Besides, many men have a turn for chemistry, and would make good chemists, who cannot afford the time or money necessary to educate themselves for university degrees; and, moreover, any degree short of Doctor of Science is no proof of proficiency in analytical chemistry. What we want is a test similar to that required in the medical profession—a test of theoretical and practical knowledge. That chemists should possess something more than a chemical education could be secured, in the case of young men, by their being required to pass some one of the recognised preliminary examinations previously to their being examined for a diploma by a board of chemical examiners. How is such a board to be appointed? By Government? Certainly not; the less Government has to do with such things the better. The reasons for our opinion on this subject we shall give on another occasion, as they would occupy too much space at present.

We look to the Chemical Society, as representing the influence and talent of the chemical body, to take this matter into its serious consideration. It is stated in the charter of this

* Aniline containing more than 5 per cent. of toluidine is not suited for the production of *Violet de Paris*.

Society that it was established "for the general advancement of chemical science, as intimately connected with the prosperity of the manufactures of the United Kingdom, many of which mainly depend on the application of chemical principles and discoveries for their beneficial development, and for a more extended and economical application of the industrial resources and sanitary condition of the community." How can the Society better accomplish this object than by appointing a board of examiners, and granting certificates to those who can give proof of their knowledge in theoretical chemistry, and show that they are competent to undertake analyses of all kinds, and conduct researches in those branches of chemical science which bear especially on the arts, manufactures, and the sanitary condition of the community. We do not propose that powers should be sought to make such a test compulsory; it would be enough that it existed and that men availed themselves of it, to secure for it a grateful public recognition. It would give a guarantee of qualification to such as required it, and would in time be acknowledged, like the diploma of the College of Surgeons, as separating regular from irregular practitioners. It would raise the chemist to a level with his brothers in science, and we should be spared the mortification of hearing of chemical assistants being occasionally requested to perform even menial offices.

LITERATURE.

HALF AN HOUR WITH THE NEW PHARMACOPŒIA.

British Pharmacopœia, 1867. Published under the direction of the General Council of Medical Education and Registration.

No two readers are, perhaps, attracted by just the same points in a new book, and individual criticism will always be more or less tinged with the colour of the critic's mind. If this be true of any book, it is so of the Pharmacopœia, for each reader of this book claims to have, to some extent, a special knowledge of its subject matter. It is, moreover, nearly certain that each has some pet theory or process, the introduction of which would, in the estimation of that particular critic, have made the book perfection, but wanting which it remains a standing monument to the incapacity of its framers. But if prejudice be not permitted to interfere with fairness, a practical critic is undoubtedly the best judge of a practical book. It is in this belief, and without any desire to cavil, that the following notes are submitted. Being literally nothing more or less than "notes" made *currente calamo*, during my first half hour with the British Pharmacopœia of 1867, on the points which first arrested my attention, I apologise even for this preface to them.

In size the Pharmacopœia is convenient—in arrangement excellent. It is a real comfort to be able to turn at once to the article or preparation required without the necessity of consulting the index; the index, too, is full to repletion.

Weights.—Grain, ounce, and pound, as in the Pharmacopœia of 1864; but here is a curious bit of inconsistency:—"Avoid," urges the preface upon the medical man, "the terms ounce and pound with reference to any but avoirdupois weight; but it will be optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such should be found to conduce to accuracy or convenience." Now, ʒj has for many successive Pharmacopœias meant the eighth part of the *ounce*, whatever value may have been given to *that*; therefore, if the symbols ℈ and ʒ *must* be used at all, this octofid division should be adhered to. Moreover, in Ireland, the weights of ℈j (= 18·22 grains) and ʒj (= 54·68 grains) have actual brass existence, and were used for many years—used until the dictum of the British Pharmacopœia of 1864 made them useless. When England and Ireland had each a Pharmacopœia and each an ounce, the difference in the drachm and scruple of the two countries was inconvenient enough; but now that they have one guide-book in common, the anomaly should not be permitted to exist. Unless all Irish scale-drawers be emptied of their drachm and scruple weights, and the lessons of the Dublin Pharmacopœia of 1851 be forgotten (the very Pharmacopœia in which the avordupois pound was first made the standard of apothecaries' weight), or unless, indeed, physicians will be sensible enough to forego the permissive licence to use the ℈ and ʒ at all, no little confusion will result.

Carbolic Acid.—"It does not affect the plane of polarisation of a ray of polarised light."

Creasote.—"It turns the plane of polarisation of a ray of polarised light to the right." The two sentences quoted are among the many instances in which pure physics seem to step in with aid just where chemistry is at fault, and I myself thought, too, as I read them, that a drop, as it were, of the admirable, but as yet unpublished researches of Professor Jellett, of Dublin, had fallen on the pages of the Pharmacopœia. It is very remarkable, as that gentleman has pointed out, that the line between organic and inorganic bodies is most sharply defined by their respective behaviour towards polarised light. In no case has it been found that a substance derived from an inorganic source affects the direction of a polarised ray. Here are two bodies which so closely resemble one another as to have many of their chemical properties in common, and to act on the senses in an almost identical manner, and yet it would almost seem that *because* one has been obtained from wood it turns the ray to the right, and *because* the other has been obtained from a mineral (even although this was once wood) it has no action on the ray. Let us hope that the polariscope may soon be found in all chemical laboratories.

Benzoated Lard.—Lard with which gum benzoin in the proportion of 160 grains to a pound has been heated. It is to be used in making some of the suppo-

sitories and ointments, among the latter those of acetate of lead and oxide of zinc. Gum benzoin has the property of retarding fatty oxidation, and ointments made with lard containing it keep very well. But, apart from this power, is the gum a desirable constituent of ointments? *Oil of Pimento*, as was pointed out some time since by a writer in the 'Pharmaceutical Journal,' possesses the same power in a remarkable degree. I have used it now for a long time, 20 minims to a pound, in zinc ointment, which it perfectly preserves. It is inexpensive, gives no trouble, and little or no smell.

CATAPLASMA SINAPIS.—Why use *boiling* water in making this? True, the linseed meal, being first added, will lower the temperature, but will the constituents of mustard poultice be always mixed in this order?

CHLOROFORM.—"Burns, though not readily, with a green and smoky flame." Can a liquid be said to "burn," even with the qualification "not readily," which will not take fire in a red-hot spoon, cannot be ignited on cotton, and extinguishes live coals? And, writing of chloroform, I note that there is no attempt at a recognised formula for *Chlorodyne*, unless it be intended that the *Tinctura Chloroformi co.*, a mixture of chloroform, alcohol, and tincture of cardamoms, shall do duty for it.

COLLODIUM FLEXILE.—Ordinary collodion, to which Canada balsam and castor-oil are added. Glycerine, two drops to an ounce, also makes collodion elastic. Why is *Blistering Collodion* omitted? It is largely used, quite as largely as the *Charta Epispastica* is likely to be.

CONFECTIO SENNÆ.—Are *figs* in this preparation of any use? The P.D. got on very well without them for some years, and unless the presence of their pulp really improves the preparation they should be discarded, in mercy to the pharmacist whose labour they so much increase.

FERRI ET QUINÆ CITRAS.—"The solution is precipitated blue by the yellow and red prussiates of potash." I have not yet made the Pharmacopœial preparation, and can only assume that this statement is correct. Being so, it is remarkable that the addition of citrate of quina to a persalt of iron should so modify its chemical properties as to cause it to precipitate *blue* with a ferricyanide.

LINIMENTUM SINAPIS COMPOSITUM.—This is practically a dilute solution of volatile oil of mustard in spirit, sufficient consistency being given to the liniment by castor oil. Castor oil is not soluble in the rectified spirit of the Pharmacopœia, but it is worthy of note that it is rendered completely so by the volatile oil and the camphor.

LIQUOR AMMONIÆ ACETATIS.—The good old formula with carbonate of ammonia restored. Theoretical chemistry is not always the best pharmacy.

LIQUOR BISMUTHI ET AMMONIÆ CITRATIS.—A really practical process, which cannot but succeed in the most moderately careful hands, and deserves all praise because it makes no attempt at that ultra-purity of product which is so rarely attained in practice. The solution contains a little nitrate of ammonia. Had crystalline nitrate of bismuth, which is now made on a commercial scale, been ordered, the formula would have been still better.

LIQUOR FERRI PERNITRATIS.—The formula for this preparation is so essentially bad that it is surprising how it can have been perpetuated. It is the old method of Mr. Ker and the P.D., except that to make up for the inferior strength of the nitric acid a larger quantity is used. There is no excuse for this, because the excellent process of Professor Procter stands ready printed in the pages of the U.S. Pharmacopœia.

LIQUOR FERRI PERSULPHATIS.—This solution is not itself used as a remedy, but is only employed in making other preparations. There is no reason, therefore, why the following formula should not be substituted for that of the Pharmacopœia. That it should be there is the excellent reason that it can thus be made with much greater certainty, and in less than half the time:

Sulphate of Iron	8 ounces.
Sulphuric Acid	6 fluid drachms.
Chlorate of Potash	320 grains.
Water	q. s.

Dissolve the sulphate of iron by heat in 10 ounces of water, to which the sulphuric acid has been added, and then add the chlorate of potash dissolved in 3 ounces of water. Cool and filter the solution.

LIQUOR LITHIÆ EFFERVESCENS.—It is well that there are now authoritative formulæ for this and the two other alkaline waters. The lithia water usually made has been far too weak to be even usefully antacid, putting out of the question its reputed solvent action on the salts of uric acid.

SODÆ CARBONAS EXSICCATA.—I have elsewhere pointed out that this preparation could be most advantageously made by heating the bicarbonate to dull redness. Dried soda thus prepared is a soft, perfectly white powder, very much more elegant in appearance than the product of the P.B. process, and is much less troublesome to make.

SODÆ CITRO-TARTRAS EFFERVESCENS.—A formula for the popular "Citrate of Magnesia," containing no magnesia, nor the sugar which is found in the commercial article.

SUPPOSITORIA.—Cocoa butter, which one scarcely recognises in its new dress of *Oil of Theobroma*, has very properly been ordered in the formulæ for these preparations. Whether its special properties are improved by its being alloyed with lard and wax remains to be seen.

SYRUPUS FERRI PHOSPHATIS.—The author of the formula for this preparation has sacrificed the permanence of the product to the elegance of the chemical reaction in the process. In practice the whole of the acetic acid cannot be washed out of the moist magma of phosphate of iron; traces of peracetate of iron soon form, and the syrup becomes coloured without any apparent cause. Let us hope that in the next edition of the Pharmacopœia *carbonate* of soda

which answers all the purpose of the acetate, will be substituted for it.

Unguentum Antimonii Tartarati.—If the tartrate of antimony were directed to be rubbed with water or glycerine before being mixed with the ointment, the danger of gritty particles of the salt causing annoyance would be obviated.

Vinum Aurantii.—Orange wine is of all vinous liquids the one most prone to further fermentive change, and 12 per cent. of alcohol (= 20·7 per cent. proof spirit) is not sufficient to prevent this. To ensure its preservation, it must contain at least 30 per cent. of proof spirit. This point is of importance, as two officinal wines—*Vinum Ferri Citratis* and *Vinum Quiniæ*—are now to be made with orange wine.

Harry Napier Draper.

Dublin, May 20.

ELEMENTARY WORKS.

Practical Chemistry: with New Nomenclature and Notation. By Stevenson Macadam, Ph.D., F.R.S.E., F.C.S.—W. and R. Chambers.

The multiplication of bad manuals of chemistry is one of the results of the remarkable development of the science during the past few years. The demand for books in which the modern views are expounded has led to the publication of many crude and worthless treatises. We are not surprised at this result, for the manufacture of shoddy thrives when there is an exceptional demand for cloth, but we are surprised at seeing on the title-pages of some of these bad books the names of men from whom we might fairly have expected better things. One of the latest offenders in this respect is the author of the above work, which has been added to the popular series of educational books published by the Messrs. Chambers.

We pity the unfortunate student whose course of practical chemistry is regulated by this defective and misleading treatise. We will not attempt to point out the various errors and omissions which may be detected by any practical chemist on a cursory examination of the book. A few examples must suffice. We will take these from the single section treating of the reactions of lead.

Ten reactions are given, of which five are faulty either by gross omission or by actual misstatement. Thus, we are informed that hydrosulphuric acid occasions a precipitate which in acid solutions is at first red. In truth, however, this red precipitate is obtained when the acid happens to be hydrochloric acid, but not when it is nitric or acetic acid. No mention is made of the solubility of chloride of lead in hot water, though this is one of its most marked characters. Potash, we are told, gives a precipitate in solutions of lead which is *insoluble* in excess. It is *soluble*. The reaction with sulphuric acid is given almost as it should be; still, we do not know why the precipitate formed is said to be *difficultly* soluble in excess of potash. In another part of the book (p. 75) we are told that the sulphate is *insoluble* in potash. Iodide of lead is said to be soluble in large excess of water. It must be a very large excess, indeed.

We cannot speak favourably of the style of the book. There is an unnecessary straining after synonyms, the most absurd manifestation of which is to be found in the direction heading the reactions of each substance. Here we have an almost regular alternation of the words "used" and "employed." The following sentence may serve as an illustration of the slip-shod style into which the author very frequently falls:

"The *metal silver* is the well-known white metal, and may be dissolved in nitric acid, HNO_3, diluted with water, and heat applied in a test-tube."

At page 135 we find the following passage: "Where the operator has reason to believe that the substance under examination is of a complex nature, and contains more than one metallic" (this limited expression is the author's) "and acid, or more than one metal, he must consult one of the larger treatises on Practical Chemistry, such as Fresenius's 'Qualitative Analysis.'" In the foregoing we most heartily concur, but would suggest that perhaps it would be better to employ the larger treatise from the first. Among the omissions of the book we notice suboxide of copper and sulphurous acid.

Inorganic Chemistry. By the late George Wilson, M.D., F.R.S.E. Revised and enlarged by Dr. Stevenson Macadam. With New Notation.—Chambers.

The first edition of this work is so well known that our duty is confined to noticing the revision and enlargement. In his attempt to modernise Dr. Wilson's exposition, the editor has betrayed his own ignorance of some of the fundamental doctrines of modern chemists. Altogether, the new matter for which Dr. Macadam is answerable is quite on a par with his independent work on Practical Chemistry.

We regret that Chemistry should be the weak point in 'Chambers's Educational Course,' for the books of this series are widely circulated.

Chemical Notes for the Lecture Room. Specially arranged for the London University Matriculation Pass. By Dr. Wood, F.C.S.—London: W. H. Warr and Co.

This little book of 96 pages "is in nowise intended to supersede the excellent works of Miller, Roscoe, and others." It consists of notes originally drawn up for the use of Dr. Wood's laboratory pupils and private classes, then printed to accompany a course of lectures delivered before the pupils of Brighton College, and finally published "in the hope of their proving useful to students preparing for the London University matriculation, the military and other examinations." Such is the account given of this work by the author in his preface.

We are sorry that Dr. Wood could not resist the temptation to print and publish; for whatever use his pupils might have made of these notes, we cannot help thinking that they ought to have been "hushed up among his friends." The author's vain hope of their proving useful to students preparing for the London University matriculation does not justify their public exposure. A book obviously intended to facilitate

cramming could not be viewed with much respect, even if it were skilfully compiled. Dr. Wood's 'Chemical Notes' is such a book badly compiled. In fact, it ought not to be spoken of as a compilation, for it may be more correctly described as a jumble.

Here are a few elegant extracts from this work:

"When kettles are quite filled with water and placed on a fire, the water frequently overflows, which is due to the fact that the water expands more than the kettle. *Compensating pendulums, etc., are examples of this.*"

"Evaporation is a term applied to liquids only. It is the conversion of liquid into vapour *without the formation of bubbles*, the vapour being allowed to escape freely into air; *e.g.*, Drying wet clothes by the fire."

"Gases unite chemically by *measure* as well as by weight; *solids and liquids unite only by weight.*"

"Charcoal has been known from very early ages."

We wonder whether matriculation students will find this sort of information useful.

The author adopts Professor Roscoe's nomenclature, and speaks of silver nitrate, barium sulphate, sodium carbonate, etc.; but on page 46 we find these names standing beside such names as *lime* carbonate and *lime* sulphate. Again, on page 76 we meet with the names *lime* phosphate and *calcium* sulphate in one sentence. Dr. Wood, speaking of the recent changes in nomenclature, says "it is difficult to give rules to meet the peculiarities of each writer." We fear that it would be impossible to give rules that would meet his own peculiarities.

There are many glaring contradictions in this book, many misstatements, and innumerable absurdities. The reactions are generally correctly represented. There is, however, an equation on page 42 that is not likely to prove useful to the matriculation student. This is supposed to represent the action of potassium upon water:

$$K_2 + H_2O = K_2O + H_2.$$

In a work which attempts to explain the principles of modern chemistry potassic hydrate ought not to have been lost sight of in this familiar reaction. Dr. Wood, however, tells us distinctly that the potassium removes the oxygen from water, "forming potassium oxide (K_2O), the H being liberated."

We are glad that this book is not intended to supersede the works of Miller, Roscoe, and others.

ROYAL SOCIETY OF EDINBURGH.

At one of the later meetings of this Society your correspondent made a preliminary communication, on behalf of Mr. Dewar and himself, respecting an investigation *On Meconic Acid*. The following is an abstract of the paper.

A general review of the salts and ethers of meconic acid seems to show that this acid is not tribasic, as is usually supposed, but dibasic, though triatomic. This induced the authors to study the action on meconic acid of hydriodic acid and of pentachloride of phosphorus, reagents which, in other cases, have served to distinguish the alcoholic from the acid hydroxyls. Some experiments on the action of hydriodic acid of constant boiling-point on meconic acid were made in this laboratory some years ago, and only showed that the first step in the reaction consists in the elimination of CO_2, and that the comenic acid formed is then reduced; they did not otherwise lead to any definite results. The authors, therefore, this time tried the action of perfectly saturated hydriodic acid on ready-made comenic acid, without, however, obtaining satisfactory results. When the substances were heated to upwards of 200° C. in a sealed tube, iodine was liberated, but the greater part of the comenic acid changed into charcoal. The action of pentachloride of phosphorus is more definite. If one molecule of perfectly dry meconic acid and three molecules of the pentachloride are heated together, by means of an oil-bath, to 100° C., there is a violent reaction, oxychloride of phosphorus distilling over and hydrochloric acid being evolved.

The residue in the retort was freed as much as possible from oxychloride by keeping it for some hours at 130° C. in a current of dry carbonic anhydride. There is very little carbonic anhydride formed in the reaction, as was shown by a special experiment, in which 4 grm. of the acid were employed. This experiment was made in a current of dry hydrogen, and the amount of carbonic anhydride formed estimated by absoption in a soda-lime tube. It amounted to about 1-40th of a molecule for every molecule of meconic acid used. The authors did not succeed in freeing the product of the reaction completely from oxychloride of phosphorus, and consequently an analysis could not be expected to give exact results; yet they made several determinations of C, H and Cl, and obtained numbers which came near enough to those required by the formula $C_7HO_4Cl_3$ to show that it was a substance of the composition of terchloride of meconyl which had been formed. The terchloride of meconyl thus obtained is an intensely red semi-solid mass, not volatile without decomposition. When treated with water it is readily decomposed with evolution of carbonic anhydride and the formation of a dark brown but clear solution. The authors made many attempts to prepare definite salts of the acid formed in this reaction, but without success. When the brown solution was thrown upon a dialyser the hydrochloric acid, in the course of a few days, completely diffused out, leaving a liquid which did not give a precipitate with nitrate of silver, but which still contained chemically combined chlorine.

When *comenic acid* was treated with pentachloride of phosphorus, a reaction similar to that observed in the case of meconic acid took place, but the chloride formed proved still more intractable than the one derived from meconic acid.

As in *pyromeconic acid* the common nucleus of the group presents itself in its simplest form, a knowledge of the structure of this substance would throw great light upon that of its two congeners. If we consider the difficulty with which pyromeconic acid forms metallic derivatives, we come to the con-

clusion that it can hardly be called an acid at all, and are led to think that it belongs to the same class of compounds as pyrogallic acid. In fact, comparing the formulæ of the two bodies, they appear to be members of the same homologous series. As, now, pyrogallic acid is known to be trihydroxyl-benzol, pyromeconic acid may be regarded as the corresponding derivative from the hydrocarbon C_5H_4. The authors tried the action of pentachloride of phosphorus on the small quantity of pyromeconic acid they had at their disposal, expecting to obtain a chloro-substitution product of that hydrocarbon. When pyromeconic acid was heated to 200° C. along with oxychloride and pentachloride of phosphorus, and the resulting mixture treated with water, a brown liquid separated out, which, on distillation, yielded a colourless oil, boiling above 200° C. This oil did not fume in air, and remained in water without dissolving for days. The analyses, however, did not bear out the authors' anticipation, the numbers agreeing very well with the formula $C_{10}H_5Cl_9O_3$ ($2C_5H_4O_3 - 3HO + 9Cl$).

Unfortunately, pyromeconic acid is a substance which it is difficult to procure in any quantity. In the experiments of the authors meconic acid did not yield more than 1 per cent. of its weight of pyromecomic acid. Until a more remunerative process for the preparation of this compound is discovered it must remain an open question whether it is a lower homologue of pyrogallic acid.

At the same meeting Dr. A. Crum Brown read a paper, supplementary to a previous communication, *On the Action of Ammonia on Dichloracetone.* The following is a *résumé* of the results :—If dichloracetone is treated with dry ammonia, the two substances combine, forming a crystalline compound of the composition $C_3H_4Cl_2O + 2NH_3$, which is stable in an atmosphere of ammonia only, but breaks up immediately when brought into contact with air or water.

W. Dittmar.

University Laboratory, Edinburgh.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

On some Compounds of Silicon, and on the Analogy of that Element to Carbon. By C. Friedel *and* A. Ladenburg.*

Wöhler and Buff,† by passing chlorhydric acid gas over crystallised silicon heated to a temperature below redness, obtained a very volatile, inflammable liquid, to which they assigned the formula $Si_3Cl_{10}H_4$ ($Si=28$). It was not, however, obtained quite pure, being contaminated with a certain quantity of silicic tetrachloride formed at the same time.

The authors of the present communication have succeeded, by a series of fractional distillations, in obtaining this volatile liquid quite pure, and have shown that it has the composition of *silicic hydro-trichloride*, $SiHCl_3$. This result was obtained both by analysis and by a determination of the vapour-density, which was found to be 4·64, the calculated value being 4·69.

Silicic hydro-trichloride boils at 34° (the crude product obtained by Wöhler and Buff boiled at 42°), and in other respects exhibits all the properties described by its discoverers. Its vapour mixed with air detonates in contact with a burning body, producing a white smoke of silica. *Water* decomposes it instantly, forming a white oxygenated product, probably *silicic hydro-trioxide*, $Si_2H_2O_3$, which is further decomposed by prolonged contact with water, with evolution of hydrogen and formation of silica. *Chlorine*, at ordinary temperatures, decomposes the inflammable silico-hydric chloride, converting it into tetrachloride; and conversely the tetrachloride is partially decomposed at a red heat by nascent *hydrogen*, yielding a small quantity of the inflammable chloride. *Bromine* does not act upon the inflammable chloride at ordinary temperatures; but the mixture, if heated to 100° in a closed vessel, becomes decolorised, doubtless yielding the *bromo-trichloride*, $SiBrCl_3$.

Silicic hydro-trioxethide, $SiC_6H_{16}O_3 = \left.\begin{matrix}(SiH)''' \\ (C_2H_5)_3\end{matrix}\right\} O_3 = Si\left\{\begin{matrix}H \\ (C_2H_5O)_3\end{matrix}\right.$.—This compound is formed by dropping absolute alcohol on silicic hydro-trichloride. Large quantities of chlorhydric acid are evolved, and on submitting the product to fractional distillation the hydro-trioxethide passes over between 134° and 137,° and tetrethylic silicate (silicic ether) at 165°.

Silicic hydro-trioxethide is a limpid liquid, having an agreeable odour like that of silicic ether, insoluble in water, but gradually decomposed by contact with moisture. It resembles silicic ether in most respects, but is distinguished by the greater inflammability of its vapour, and by its property of giving off hydrogen when mixed with alcoholic ammonia. When a piece of *sodium* is thrown into it, a small quantity of hydrogen is first evolved (due, probably, to the action of the sodium on a small quantity of alcohol formed by the decomposition of the ether by moisture), and on gently heating the liquid after this action has ceased, a gas is evolved, consisting of pure *siliciuretted hydrogen*.

When the siliciuretted hydrogen thus obtained is decomposed by aqueous potash in a tube standing over mercury, silica is formed, and a volume of pure hydrogen is set free, equal to four times that of the original gas, showing that the siliciuretted hydrogen consists of *silicic tetrahydride*, SiH_4.

The formation of siliciuretted hydrogen by the action of sodium on the hydro-trioxethide is attended with that of tetrethylic silicate, according to the equation—

$$4SiH(C_2H_5O)_3 = SiH_4 + 3Si(C_2H_5O)_4;$$

the sodium retains its lustre, and appears to act merely by contact.

Siliciuretted hydrogen, obtained as above, does not take fire spontaneously in the air under the ordinary pressure; but on passing a bubble of air into the rarefied gas standing over mercury, it takes fire and

* 'Comptes rendus,' lxiv, 359 (25 Février, 1867).
† 'Wöhler and Buff, 'Ann. Ch. Pharm.,' civ, 94.

yields a deposit of brown amorphous silicon mixed with silica. This may explain why the impure gas mixed with hydrogen is more inflammable than pure siliciuretted hydrogen. In this respect, also, siliciuretted hydrogen bears some resemblance to phosphoretted hydrogen.

The compounds above described are analogous in composition to certain organic compounds of the formic series, and may, in fact, be derived therefrom by simple substitution of silicon for carbon. Thus, the hydrochloride, $SiHCl_3$, is analogous to chloroform, $CHCl_3$; the ether, $SiH(C_2H_5O)_3$, to the tribasic formic ether, $CH(C_2H_5O)_3$, discovered by Williamson and Kay; siliciuretted hydrogen, SiH_4, to marsh gas, CH_4; and the body, $Si_2H_2O_3$, to the hypothetical formic anhydride, $C_2H_2O_3$. These silicic compounds might therefore be designated as *silici-chloroform, tribasic siliciformic ether, silicoformic anhydride*, etc. Their composition exhibits in a striking manner the analogy existing between silicon and carbon, and affords a further proof of the tetratomicity of silicon.

Action of Reducing Agents on Nitric Acid and Nitrates. *By* A. Terreil.*

The author's experiments show that—

1. In presence of nascent hydrogen and other reducing agents, nitric acid and nitrates are converted into nitrous acid and nitrites, previous to passing into the state of ammoniacal salts.

2. The solutions resulting from this intermediate reduction decolorise permanganate of potassium; and, consequently, the presence of nitric acid and nitrates may become a source of serious error in the estimation of iron by means of a permanganate. Chlorates, on the other hand, do not interfere with the determination.

3. The reaction just indicated affords a very delicate test for nitric acid and nitrates. Waters containing traces of nitrates decolorise a weak solution of permangate, when they are acidulated with sulphuric acid and left in contact with zinc.

4. Permanganate of potassium completely absorbs nitric oxide, and converts it into nitric acid; it likewise converts nitrous acid and nitric peroxide into nitric acid, but has no action on nitrous oxide.

On some Basic Sulphates of Aluminium. *By* H. Debray.†

Zinc and calcic carbonate decompose a solution of alum or aluminic sulphate, forming insoluble basic salts; the action of zinc on aluminic sulphate has, indeed, been recommended by the author as a means of separating alumina from glucina, which, under similar circumstances, forms a very soluble basic salt.

α. A basic potassio-aluminic sulphate,

$$\left.\begin{matrix} K_2O.SO_3 \\ 3(Al_2O_3.SO_3) \end{matrix}\right\}.9H_2O,$$ having the same composition as lœwigite, and differing from alunite only by containing 3 at. water in addition, is produced, with evolution of hydrogen, by the action of zinc on a solution of common alum. The action is slow, even in a warm solution, unless assisted by placing the zinc in contact with lead or platinum. By operating in a platinum capsule at 100°, the basic salt is readily obtained as a crystalline precipitate. Like alunite and lœwigite, it is nearly insoluble in nitric and in chlorhydric acids, and can only be attacked by sulphuric acid diluted with an equal bulk of water. It gives off nearly all its water at a low red heat, and the residue, heated to bright redness, is resolved into sulphuric anhydride, alumina, and potassic sulphate.

β. Tetrabasic aluminic sulphate, $4Al_2O_3.3SO_3.36H_2O$, is produced by digesting finely divided calcic carbonate for several days in a cold solution of alum in excess. It is perceptibly crystalline, and very soluble in dilute acids, even in warm acetic acid, a character by which it is distinguished from the preceding salt.

The same salt is likewise produced by the action of zinc on a cold solution of aluminic sulphate. The action is very slow, even in a platinum dish, but after a week a transparent jelly is obtained, which, when separated, by washing, from zinc and excess of aluminic sulphate, and dried over oil of vitriol, solidifies to small transparent masses, having a vitreous fracture, and exhibiting the same composition as the product last described, notwithstanding the difference of physical character.

γ. A pentabasic aluminic sulphate, $5Al_2O_3.3SO_3.20H_2O$, is obtained by gently boiling a solution of aluminic sulphate in excess, with zinc in a platinum dish. A granular precipitate is thus formed, easy to wash and soluble in dilute acids; it gives off its water at 100°.

On Pseudomorphine. *By* O. Hesse.*

The author has submitted pseudomorphine to a careful re-examination. He prepares it by the following process:—The ordinary purified mixture of hydrochlorates of morphine, codeine, etc., is dissolved in alcohol, and mixed with a small quantity of alcoholic ammonia, whereby the morphine is precipitated, but pseudomorphine remains in solution. After filtration the liquid is slightly supersaturated with hydrochloric acid, the alcohol distilled off, and the residual solution filtered through charcoal; on neutralisation with dilute ammonia a voluminous precipitate is thrown down, principally consisting of pseudomorphine. This is well washed with water, dissolved in acetic acid, and filtered. The filtrate is mixed with such an amount of dilute ammonia that it still faintly reddens blue litmus paper; the precipitated pseudomorphine is then converted into hydrochlorate, which salt must be purified by several crystallisations from water. The hydrochlorate, on admixture with ammonia, then yields the pure alkaloïd. Ordinary opiums contain about 0·02 per cent. Thus prepared, pseudomorphine is a white crystalline substance, acquiring a silky lustre when moistened with water, or almost any aqueous solution. After continued desiccation it has only a dead white ap-

* 'Bull. Soc. Chim.' [2], vii, 7. † Ibid. [2], vii, 9.

* 'Ann. Ch. Pharm.,' cxli, 87.

pearance, and ultimately becomes horny and transparent. Pseudomorphine is insoluble in water, alcohol, ether, chloroform, carbonic disulphide, dilute sulphuric acid, and sodic carbonate; but it dissolves readily in aqueous solutions of potash, soda, and lime. Aqueous ammonia takes up but a small quantity; alcoholic ammonia easily dissolves it. Pseudomorphine has no basic reaction. It gives an olive-green colour with sulphuric acid, an intense orange-red with nitric acid, and a blue with ferric chloride. Both the free substance and its salts are tasteless. When pseudomorphine is dried at 120° it has the composition—

$$C_{17}H_{19}NO_4$$

(differing from morphine only by containing one additional proportion of oxygen), but, if dried in air, it has approximately the formula—

$$C_{17}H_{19}NO_4 + Aq.$$

It appears to be identical with the oxymorphine of Schutzenberger.

The salts of pseudomorphine are either prepared from the hydrochlorate by double decomposition or by the direct action of an acid on the free alkaloïd; which of the two methods is selected depends on the solubility of the salt produced. The hydrochlorate—

$$C_{17}H_{19}NO_4,\ HCl + Aq.$$

is a crystalline, white powder, insoluble in alcohol or dilute sulphuric acid. It dissolves in seventy parts of water at 20°. The platinum salt—

$$C_{17}H_{19}NO_4,\ HPtCl_3{}^*$$

is yellow, amorphous, and slightly soluble in hydrochloric acid. The sulphate—

$$2C_{17}H_{19}NO_4,\ H_2SO_4 + 6Aq.$$

crystallises in small, white laminæ, very similar to gypsum. 422 parts of water, at 20,° only dissolve one part of the crystallised salt, which is also insoluble in alcohol and ether. The sulphate reddens litmus. The oxalate—

$$2C_{17}H_{19}NO_4,\ H_2C_2O_4 + 6Aq.,$$

which crystallises in very minute prisms, dissolves only in 1940 parts of water at 20°, and has likewise an acid reaction. Hesse has also qualitatively examined the tartrate, nitrate, chromate, iodide, aurochloride, and mercuro-chloride; they possess precisely the characters which such derivatives of a sparingly soluble, colourless alkaloïd might be expected to exhibit.

On Sulphobenzide. *By* R. Otto *and* H. Ostrop.†

The authors have made a somewhat minute inquiry as to the accuracy of the results obtained by Gericke‡ when investigating sulphobenzide. After recapitulating the most important published statements of that chemist, they give an account (1) of the action of chlorine on sulphobenzide at an elevated temperature and in diffuse light. At the ordinary temperature sulphobenzide readily absorbs either dry or moist chlorine; at or above the melting-point (120°—130°) the action proceeds more speedily, and a yellow oil gradually distils away in the stream of gas. This oil, which contained much free chlorine and hydric chloride, was submitted to fractional distillation. From the distillate under 150° a quantity of a substance boiling at 134°—136° was separated by the same process; it proved to be pure monochlorobenzol, identical with that obtained directly from benzol itself. The portion boiling above 150° yielded a very large fraction between 230° and 250°. This had the characteristic smell of sulphobenzolous chloride; and that it really consisted of the body thus indicated was shown by treatment with alcoholic potash and analysis of the potassium-salt (potassic sulphobenzolate) so produced. Finally, the residue in the retort was carbonaceous, and doubtless produced by the decomposition of the chloride just referred to. Under the circumstances specified the following equation represents the reaction which takes place:

$$(C_6H_5)_2SO_2 + Cl_2 = C_6H_5Cl + C_6H_5ClSO_2.$$

The action of chlorine is therefore perfectly analogous to the action of phosphoric chloride, as previously described by Otto:

$$(C_6H_5)_2SO_2 + PCl_5 = C_6H_5Cl + C_6H_5ClSO_2 + PCl_3.{}^*$$

The authors then describe (2) the action of dry chlorine on sulphobenzide in direct sunlight and at the ordinary temperature. There is an energetic attack, accompanied with a decided rise of temperature; the sides of the retort and receiver are gradually covered with a coating of crystals, which increases as the current of gas continues. The operation is terminated when chlorine is no longer absorbed; and the crystals (B) are then separated from the accompanying yellow oil (A) by filtration through asbestos. (A), after drying over oil of vitriol and potash, yielded unsatisfactory analytical results, showing, however, that the oil was not a homogeneous substance; that it probably contained a small quantity of sulphobenzide, and that sulphuric dioxide had been expelled by the chlorine. This last conclusion was verified by passing the gas which escaped absorption through a Wolffe's bottle containing water; sulphurous acid was thus readily detected in the first part of the process. The crystals (B) were washed with a little ether, pressed between paper, crystallised twice from hot absolute alcohol, and then analysed. The numbers obtained corresponded to the formula—

$$C_6H_5Cl_7.$$

They are insoluble in water, and very little soluble in cold or hot ether, but dissolve in a large amount of hot alcohol. From the last-named solvent they separate in small, white quadratic prisms, having the lustre of glass; their fusion-point is 255°—257° (uncorrected) and they can be sublimed without decomposition. Alcoholic potash attacks this substance, with formation of potassic chloride.

The authors propose to account for the formation of the compound last mentioned by supposing successive molecules of chlorine to attach themselves to the monochlorobenzol first formed; and also by the replacement of sulphuryl in sulphobenzolic chloride

* Pt = 98·9. † 'Ann. Ch. Pharm.,' cxli, 93. ‡ Ibid., c, 207.

* 'Ann. Ch. Pharm.,' cxxxv, 154.

by an equivalent quantity of chlorine, followed by further molecular addition of the same element. They believe the oil (A) to consist, on the other hand, of a mixture of chlorinated derivatives, into which the chlorine has entered by way of substitution. The marked difference between the above results and those of Gericke is alluded to with considerable emphasis.

By the action of alcoholic potash on (A) in the usual manner, certain new chlorine derivatives of benzol (3) were obtained. The first of these, *tetrachlorobenzol*, boils at 250°—260°, and, when perfectly pure, melts at 33°. It crystallises from its saturated alcoholic solution in small white needles; from a more dilute solution it separates in prisms, grouped round a point. Tetrachlorobenzol is soluble in alcohol, ether, and benzol, but not in water; its odour resembles that of the dog-rose. As thus prepared, it is evidently not identical with the substance described under the same name by Jungfleisch,* which is said to fuse at 139°. *Pentachlorobenzol* accompanied the potassic chloride which had separated out from the original alcoholic mixture, and which had been washed with cold absolute alcohol. It was extracted from the chloride by means of hot absolute alcohol, and purified by two crystallisations. Some of the same substance was found in the retort from which tetrachlorobenzol had been distilled. It forms fine colourless needles, an inch long, which are destitute of smell, and have a silky lustre. Alcohol and ether, on heating, easily dissolve pentachlorobenzol; if cold, they scarcely affect it. The compound becomes pasty at about 170°, and melts completely at 215°—220°. A body having the same composition, but fusing at 69°, has also been described by Jungfleisch. Indeed, the mother-liquor from which the preceding pentachlorobenzol had been procured, appeared to contain an isomer of lower fusion-point (79°—85°) and more readily soluble.

Action of Disulphide of Chlorine on Metals and Metallic Sulphides. By E. Baudrimont.†

Respecting the action of *metallic antimony* on disulphide of chlorine, the author confirms the result above described by M. Chevrier.

Antimonious sulphide is also strongly acted upon by disulphide of chlorine, thus—

$$3Cl_2S_2 + Sb_2S_3 = 2SbCl_3 + S_9.$$

Orpiment, As_2S_3, is still more energetically attacked, yielding precisely similar products.

Tin, very gently heated with disulphide of chlorine, acts strongly and with great rise of temperature, forming stannic chloride, $SnCl_4$.

Stannic sulphide (mosaic gold) acts in a similar manner, but less strongly.

Aluminium foil, gently heated with the disulphide, decomposes it with violence, a brownish liquid distilling over spontaneously, and yielding colourless crystals, probably consisting of a compound of Cl_2S_2 with chloride of aluminium.

Mercury and *mercuric sulphide*, heated with disulphide of chlorine, are slowly attacked, yielding free sulphur, and mercurous or mercuric chloride, according to the proportion of mercury present.

Disulphide of chlorine, at the boiling heat, acts slowly on *iron*, converting it into ferric chloride; slowly also on *zinc*, not at all on *sodium* or *magnesium*.

In general, it appears that metals and their sulphides are attacked by disulphide of chlorine with greater facility in proportion as their chlorides are more volatile.

On Hydroterephtalic Acid. By R. Molis.*

Terephtalic and phtalic acids resemble each other in their capability of combining with hydrogen. In the former case hydroterephtalic acid,

$$C_8H_8O_4,$$

is produced. The process for obtaining hydroterephtalic acid consists in dissolving terephtalic acid in a rather concentrated alkaline solution, leaving this in contact with sodium-amalgam for some days, and then adding hydric chloride. A white, flocky precipitate falls, which is quite insoluble in water, and is constituted of the acid in question. Hydroterephtalic is scarcely distinguishable in appearance from terephtalic acid. It reduces an ammoniacal argentic solution on boiling.

On the Action of Nascent Hydrogen on Cyanacetic Acid. By C. Gilbert Wheeler.†

When cyanacetic acid is treated with sulphuric (or acetic) acid and zinc, no sarkosine is formed, but the products of the reaction consist of acetic and formic acid and ammonia:

$$C_2H_3(CN)O_2 + H_2 + 2H_2O = C_2H_4O_2 + CH_2O_2 + NH_3.$$

Ethylic cyanacetate, when added to a mixture of ammonia and zinc, or treated with hydric sulphide, shows no more disposition to yield sarkosine than the hydric salt.

On the Action of Sodium on Camphor. By H. Baubigny.‡

Camphor was dissolved in toluol and heated to 90° with sodium. There is a violent action; but, as a special experiment showed, no hydrogen gas is evolved. The author, therefore, believed that sodium had indeed expelled hydrogen from one part of the camphor, but that another part of the camphor had formed borneol with the hydrogen so expelled. As soon as the action had terminated water was added to the mixture and the toluol distilled away. The residue was pressed between folds of paper, purified by sublimation, and then treated (according to Berthelot's method§) with twice its weight of stearic acid. After the camphor had been removed from this by a second distillation, the ether was decomposed with soda-lime and yield pure borneol. The following equation is both qualitatively true and in agreement with the weight of sodium employed:

$$3C_{10}H_{16}O + Na_2 = 2C_{10}H_{15}NaO + C_{10}H_{18}O.$$

* 'Comptes rendus,' lxii, 635.
† Ibid., lxiv, 369 (25, Février, 1867).

* 'Zeit. Chem.' (1867), 68.
† Ibid. (1867), 69.
‡ Ibid. (1867), 71.
§ 'Chem. Org. fond. sur la Synthèse,' i, 147.

ROYAL SOCIETY.

THURSDAY, MAY 23.

At this meeting a paper was read *On Pyrophosphoric Acid, with the Pyro- and Tetra-phosphoric Amides*, by J. H. Gladstone, Ph.D., F.R.S.

This paper consisted of two parts, the first a brief account of a number of compound bodies which the author proposes continuing to describe in detail in the publications of the Chemical Society, the second his theory of their formation and rational constitution.

Pyrophosphoric acid is quadribasic, and is very apt to form acid amides. Their composition is as follows:

Pyrophosphoric acid	$P_2H_4O_7$
Pyrophosphamic acid ...	$P_2(NH_2)H_3O_6$
Pyrophospho-diamic acid	$P_2(NH_2)_2H_2O_5$
Pyrophospho-triamic acid	$P_2(NH_2)_3HO_4$

The ferric and some other salts of the original acid and the first amide are capable of existing in an allotropic condition, when they are far less soluble in acids or in certain salts than the normal compounds are. This change is brought about by heating them in the presence of sulphuric acid.

The above compounds may be all produced by the action of ammonia and water on oxychloride of phosphorus. Starting with the same substances, another series of acid amides may be prepared. These contain P_4...., and are related to Fleitmann and Henneberg's phosphoric acid, $P_4H_6O_{13}$. They are—

Tetraphospho-tetramic acid	$P_4(NH_2)_4H_2O_9$
Terammoniated tetraphospho-diamic acid........................	$P_4N_5H_{17}O_{11}$
Tetraphospho-pentazotic acid......	$P_4N_5H_9O_7$.

Several products of decomposition of these bodies were described, including some pyrophospho-nitrylates, as P_2NAgO_4.

The amidated oxychlorides $P(NH_2)Cl_2O$ and $P(NH_2)_2ClO$ had not been separated in a state fit for analysis, but there could be little doubt of their existence.

The author considered the formation of these compounds containing P_2.... and P_4.... from a substance, PCl_3O, which contains only one atom of phosphorus, as dependent on the fact that two molecules of the simple or amidated oxychloride attack simultaneously each of the atoms of hydrogen in water, and thus the resulting acid is built up on the water type. His argument led to the following as the rational formulæ of the simple acids:

$$\text{Pyrophosphoric acid} \quad \left.\begin{matrix} P(HO)_2O \\ P(HO)_2O \end{matrix}\right\} O$$

$$\text{Tetraphosphoric acid} \quad \left.\begin{matrix} \left.\begin{matrix} P(HO)_2O \\ P(HO)\ O \end{matrix}\right\} O \\ \left.\begin{matrix} P(HO)_2O \\ P(HO)\ O \end{matrix}\right\} O \end{matrix}\right\} O$$

In the amides HO is replaced by NH_2.

VARIA.

The foundation-stone of the Hall of Arts and Sciences was laid by Her Majesty on Tuesday last with great ceremony. The hall, when finished, will accommodate six thousand persons, and is intended for National and International Congresses on subjects connected with Science and Art—a remarkably vague purpose.

The following pensions on the Civil List have been recently granted:—£100 a year to Lady Harris, widow of Sir William Snow Harris, in consideration of her husband's valuable invention of the system of lightning conductors: £100 a year to the Rev. Miles Joseph Berkeley, on account of his eminent services, as a botanist, to practical horticulture and agriculture.

With regard to the damaged Atlantic Cable of 1866 it appears that Mr. Willoughby Smith, who was sent specially to Valentia to report, confirms the previous tests fixing the injury at about 3½ miles from the station at Heart's Content, or within 1½ or 2 miles of the land, and therefore in shallow water. Arrangements have been made between the Anglo-American Telegraph Company and the Telegraph Construction and Maintenance Company for the immediate repair of the accident, and a vessel fitted with all needful appliances, and carrying out a skilled staff, will be soon despatched from the Thames. It is consequently expected that within three weeks the cable will again be in perfect working order.

In a former number (April 20) we called attention to the proposed amendment of the Pharmacy Act, and stated that the Council of the Pharmaceutical Society were threatened with the opposition of those "pharmaceutical chemists" who regarded the concessions to ordinary chemists and druggists as too liberal. We are delighted to hear that the measure framed by the Council received the confirmation of a special meeting of the Society held last week, and that there is now a fair prospect of obtaining an effective and satisfactory Act of Parliament to regulate the sale of poisons and the practice of Pharmacy.

Mr. Seymour Haden has resigned both his jurorship and honorary surgeoncy to the Department of Science and Art.

The report of the Ladies' Medical College for the three years ended with the present month states that the third annual session of the society's teaching operations has closed with results that are both satisfactory and promising. Fifty ladies have entered as students, of whom twelve entered during the first session, nine during the second, and twenty-nine during the third.

According to the 'Melbourne Age' a discovery has been recently made in South Australia of a lode of bismuth, samples of the metal being now to be seen at the Melbourne Exchange, to which place it has been sent from the neighbouring colony. This metal is very valuable if found in quantity, and it is stated that the lode discovered contains abundance of rich stuff, but being situated about 200 miles in the interior, some serious difficulties in the cost of carriage have been encountered.

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

MEETINGS FOR THE FORTHCOMING WEEK.

May.

Tuesday, 28. Royal Institution. 3 p.m. Prof. W. A. Miller, *On Spectrum Analysis.* Civil Engineers. 8 p.m.

Wednesday, 29. Society of Arts. 8 p.m.

Thursday, 30. Royal Institution. 3 p.m. Prof. Huxley, *On Ethnology.*

Friday, 31. Royal Institution. 8 p.m. T. Sterry Hunt, Esq., *On the Chemistry of the Primæval Earth.*

June.

Saturday, 1. Royal Institution. 3 p.m. Prof. Huxley, *On Ethnology.*

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A COURSE OF SIX LECTURES ON

COAL-GAS,

DELIVERED AT THE ROYAL INSTITUTION OF GREAT BRITAIN.

BY

EDWARD FRANKLAND, F.R.S., ETC.

LECTURE IV.

Conditions of luminosity of a gas-flame—Effect of atmospheric pressure—Effect of temperature—Illuminating power of the same gas when burned at different rates—Double cylinder gas lamp—Increase of light by heating air and gas before combustion—Loss of light by glass shades—Constituents of crude coal-gas—Impurities—Sulphuretted hydrogen—Bisulphide of carbon.

The investigation which we carried on in the preceding lectures of this course led us to the conclusion that the luminosity of a gas-flame depends upon two essential conditions:

1. Upon the amount and also the quality of the dense hydrocarbon vapours in the shell of combustion of the flame; and

2. Upon the temperature to which these dense hydrocarbon vapours are heated.

In the last lecture we devoted our attention to the circumstances which affect the first of these conditions, and ascertained that the amount and quality of these hydrocarbons mainly depend upon—

1. The access of the external air to the flame;

2. The velocity with which the dense hydrocarbon vapours pass through the flame; and

3. The pressure of the atmosphere at the time the flame is burning.

At the conclusion of the lecture we were investigating the latter circumstance, and as the result of numerous experiments we obtained the law that the decrease in the illuminating power is directly proportional to the decrease in atmospheric pressure. As a concrete expression of the action of this law, we may say that if we begin with a flame which gives 100 units of light at 30 inches of mercurial pressure, we shall lose 5·1 of these units of light every time the barometer sinks one inch.

Now, what is the cause of the decrease of luminosity by the diminution of atmospheric pressure, and the corresponding increase of luminosity by the augmentation of atmospheric pressure? The chief cause of the difference is the increase in the volume, and therefore decrease of the density of those heavy hydrocarbon vapours to which we have attributed the luminosity of a gas-flame when the atmospheric pressure is reduced, and *vice versâ*. By such a diminution of the density of these vapours it is obvious we must lose a portion of the luminosity they possess at the ordinary atmospheric pressure, as was exemplified in the combustion of arsenic in rarefied oxygen. This effect of pressure on the density of gases we have already investigated tolerably fully; but I wish to bring before you one or two more experiments in connection with it.

In the first place, allow me to recall to your memory an experiment we made with the apparatus before me, in which we enclosed a mixture of two volumes of hydrogen and one of oxygen, at ordinary atmospheric pressure, and then fired the mixture by the electric spark. You noticed, at the moment of ignition, that a brilliant light was produced, whereas, when a mixture of the same gases was freely exposed to the air in soap bubbles, no trace of luminosity could be distinguished at the moment of the explosion. The difference between the results in the two experiments lies partly in the greater temperature we had in the interior of the strong vessel, which allowed of no expansion of the gases at the moment of explosion; but it depends principally upon the greater density of the gases under this condition of combustion. The gases in this apparatus possessed, at the moment of ignition, ten times the density of the gases exploded in free air. I have here a Cavendish's eudiometer, which has been filled with a mixture of oxygen and hydrogen, and I will pass an electric spark through it. This mixture is at the ordinary atmospheric pressure, and, therefore, at the moment of ignition it will be ten times as dense as when exploded in open air. [Experiment performed, and a dazzling light produced.] I will now put into this vessel the same mixture of gases, but at a pressure to the extent of one tenth of an atmosphere only. On explosion the temperature will be somewhat lower than before, but immensely higher than when hydrogen burns in common atmospheric air, and at the moment of ignition the gaseous mixture will only have the same pressure as that of atmospheric air. Therefore, we may expect a greater diminution of light; indeed, it will not be much greater than that which results from the combustion of hydrogen in ordinary atmospheric air. [Experiment performed.] At the moment of the explosion we had a pressure of about 30 inches of mercury in the interior of the vessel, consequently the ignited product of combustion—steam—had only the same density as it possessed when formed by the combustion of the gases in free air, and the light produced upon ignition was only just perceptible through the theatre.

There is one more experiment in the same direction which will complete this part of our subject, namely, the demonstration of the dependence of light upon the density of the gases at the time of their ignition. The following is the experiment:—Fill a Cavendish's eudiometer with a mixture of atmospheric air and hydrogen—the same mixture which we have when a flame of hydrogen burns in free air—and which, as we have seen, produces practically no luminosity at all. I adapt, however, the conditions of this experiment in such a way that at the moment of ignition there shall be a pressure of ten atmospheres inside the glass vessel. In order to get this pressure we must pump in some additional gas beyond that which enters the vessel at ordinary atmospheric pressure, and we shall then get just such a pressure as we had in the first experiment. But you must remember that, in the experiment with the mixed gases which we are now going to explode, we have a great quantity of nitrogen, and all this nitrogen shares the heat pro-

duced by the explosion, consequently the temperature will be greatly diminished; still we shall find that we get a much greater amount of light—not so dazzling as in the first experiment, but yet sufficient to exemplify the difference between the burning of these gases at the common pressure of the atmosphere and burning them under the increased pressure of ten atmospheres, and when, therefore, they are ten times as dense. [Experiment performed.] Such, then, is the first and chief cause of the variation in the amount of light which accompanies variations in atmospheric pressure.

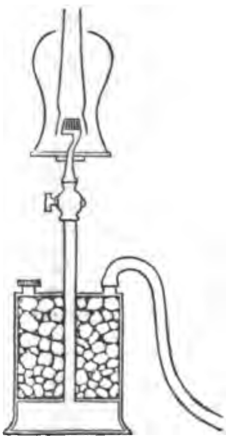
But there is also another cause, which was believed, till lately, to be the only one, namely, the access of external atmospheric air in larger quantity into the interior of the flame when the latter burns under reduced pressure, and its comparative exclusion when the combustion takes place under increased pressure; the effect being due to the greater mobility of gaseous particles at low than at high pressures.

Now, the operation of the law of reduction of light by reduction of pressure is such, that the illuminating effect of the same gas, when burned in different localities, is liable to very considerable variations. For instance, if we were to burn in Munich the same sample of gas that we are burning in London—Munich being 1700 feet above the level of the sea—we should find that an amount of gas which here gives the light of 100 candles would there give only the light of 91 candles; and if the same gas were burned in the city of Mexico, which is about 7400 feet above the level of the sea, it would give the light of only 61½ candles. These calculations are entirely independent of the consideration of change of volume; if this be taken into account, the difference becomes much greater. Equal volumes of gas burned in London and Mexico would give quantities of light which would bear the proportion of 100 to 46·2. So much, then, for the first condition of luminosity—viz. that condition which depends upon the amount and quality of the dense hydrocarbon vapours contained in the shell of combustion at any given moment.

We have now to look at the second condition, namely, the temperature to which those dense hydrocarbon vapours are heated—the temperature to which the flame is raised. The light of every ignited body is augmented by an increase of temperature. For instance, I take a cylinder of lime, and heat it by means of a hydrogen flame. The result is very little luminosity indeed. But if the temperature be increased, which can be done by feeding the hydrogen flame with oxygen, we find that the luminosity of the little cylinder of lime is increased enormously. From this experiment we see that temperature is an essential condition determining the intensity of the light emitted by any ignited solid substance. The same is also true of a liquid. If we take a piece of platinum wire, and hold it in the flame of hydrogen alone, we get a very slight amount of luminosity. But when the flame is fed with oxygen the platinum is liquefied, and you observe the brilliant light obtained, the reason being that the temperature has become very much higher. In fact, in the combustion of hydrogen in air we get a temperature of 3776° F., whereas when we feed the flame with oxygen we raise the temperature to 7364° F.

We may illustrate this further by another experiment. Here is a piece of carbon which I ignite in this hydrogen flame. You perceive merely a dull red glow; now I introduce oxygen, and the light emitted is considerably increased; but if this carbon be made part of a voltaic circuit, as is now being done, its temperature is enormously increased, and so is its luminosity.

What is true of solids and liquids in this respect is true also of gases and vapours. Hence, if the temperature of a gas-flame be augmented, the same amount of luminous heavy hydrocarbon vapours will emit more light—nay, a much less amount of hydrocarbon vapours may emit more light than a larger quantity at a lower temperature. Here, for instance, is a common Argand gas-burner, from which gas is burning in the ordinary manner. I now introduce a



Heated-air Gas-lamp (see p. 171). The pedestal is arranged as a naphthaliser.

stream of oxygen into the interior of the flame, and you see that we obtain a great increase of luminosity. Here, too, is another apparatus which will serve to illustrate the same thing. I have before me a jet, from which coal-gas is burning freely in air. We get a certain amount of light. But now, if I feed the interior of the flame with oxygen, I raise the temperature of the hydrocarbon vapours very considerably, and the result is a great increase in the intensity of the light. In both those experiments there cannot be a doubt that the amount of heavy hydrocarbon vapours in the flame, when the latter was emitting the greatest amount of light, was much less than when it was fed with atmospheric air, because in the former case more oxygen gained admission to the interior of the flame, and consumed a considerable amount of the heavy hydrocarbon vapours; consequently a smaller amount of hydrocarbon vapour, if heated to an intense temperature, will produce more light than a larger quantity burned in atmospheric air.

Now, the temperature of an ordinary gas-flame may be augmented in three different ways. In the first place, by the process we have just been adopting, namely, by feeding it with oxygen. But this process is impracticable; we could never submit to a double set of pipes, one supplying coal-gas and the other oxygen.

The second plan by which the temperature of a gas-flame may be augmented is by increasing the cooling surface of the flame. This is a very important condition in the economical consumption of gas; and it is well known that if the volume of the flame be increased in proportion to its surface, an increased amount of light is obtained. Upon this depends the fact that a large gas-flame gives more light per cubic foot of gas consumed than a small one, the gas being of the same quality in both cases. This result is shown in a series of experiments with two different kinds of gas, No. 1 and No. 2, of which the following table gives the results:

Illuminating Power of the same Gas when Burned at Different Rates.

Rate per hour.	Illuminating Power per Cubic Foot per hour. No. 1.	No. 2.
0·3 cubic feet	3·3 candles	—
1 „	6·5 „	—
2 „	7·2 „	3·0 candles.
3 „	8·6 „	3·4 „
4 „	— „	3·8 „
5 „	10·5 „	4·0 „

In fact, if in any given room or theatre, for instance, you required to consume 100 cubic feet of gas per hour, you would get more light if you burned that gas in a single flame than if you consumed it in a number of separate flames—*i.e.*, 20 burners, consuming each 5 feet of gas per hour, would give less light than if the whole 100 cubic feet were burned in the same time in a single burner.

The third process by which the temperature of a gas-flame may be augmented consists in heating the air with which it is supplied, or both the gas and the air, to a high temperature—say to the temperature of melting lead—before entering into combustion. This is a very important consideration in the consumption of gas, and I will endeavour to exemplify it by a simple experiment. The apparatus I employ consists of a charcoal furnace, with numerous apertures at the sides for the admission of air. Through the centre of this furnace rises a wrought-iron tube, which has an internal diameter of about one inch, and which is designed to supply hot air to the gas-flame. Inside this wrought-iron tube is a smaller one of copper, through which gas is conveyed to the top of the furnace. I ignite this gas at the extremity of the copper tube, and then, upon a little air-tight ledge provided for the purpose, I place a glass chimney, so that the gas-flame shall be fed with hot air only. There is another similar copper tube, from which a similar gas-flame is burning in cold air. You observe at once the great difference in the lumosity of the two flames. The superior light given by the gas which passes through the heated tube in the furnace is due entirely to the circumstance that the gas and the air are heated nearly to redness before they come together for combustion.

This process of heating both air and gas in the consumption of the latter has been applied in the construction of a lamp, of which I have here a specimen. (See fig.) It consists of a stand or pedestal, containing a tube through which the gas passes. On the top of this tube is a Leslie burner, though any other form of Argand burner may be employed. The burner is furnished with a chimney of the kind used with the Leslie burner, a little contracted near the flame. But the peculiarity of the construction of this lamp consists in the introduction in the gas-pillar of a circular piece of plate-glass, upon which a second glass shade can rest air-tight. This arrangement obviously causes the atmospheric air to stream down the heated sides of the internal glass. The air thus becomes highly heated before it is brought in contact with the gas, and, as this very hot air streams over a portion of the burner, it raises the burner itself to a temperature not far below redness, and thus both air and gas are strongly heated before combustion. In this way a very considerable increase of light is produced with the same amount of gas, or the same amount of light can be obtained with a greatly diminished consumption of gas. Here is a table showing the result of experiments made with a lamp of similar construction, in which, however, the second glass was placed very much nearer to the internal, so that the gain was greater than it would be with the lamp now before me.

Increase of Light by Heating Air and Gas before Combustion.

Cubic Feet of Gas per hour.	Light with Air and Gas cold.	Light with Air and Gas hot.
2·2	—	13·0 candles.
2·6	—	15·5 „
3·3	13·0 candles	21·7 „
3·7	15·5 „	— „

Gain in light with equal consumption of gas.. 67 p. c.
Saving of gas with equal light .... 46 „

There is an experiment which I have repeatedly made upon this table before you, and which has always struck me as curious in its results. It is the one in which atmospheric air is made to burn in coal-gas. I have here a glass cylinder, filled with coal-gas, inside of which I ignite a jet of air. Now, the curious thing which always struck me in connection with this experiment was this—that a jet of air burning in coal-gas gives practically no light. The cause is, doubtless, this, that when coal-gas is burnt in atmospheric air you have a thin stratum of coal-gas surrounded on all sides with radiating surfaces of flame. The hydrocarbons within this stratum are not only thus exposed to radiation from all sides, but they are compelled to pass through the flame. The case is, however, very different if you reverse the conditions, and have a flame of air burning in coal-gas. Here the coal-gas is exposed to radiation on one side only, and is not compelled to pass through the flame. If this explanation be correct, and we provide a second flame to radiate through the gas,

then the sheet of gas between the two flames ought to be in much the same condition as the thin sheet of gas in an ordinary fish-tail gas-flame, and we ought to get increased luminosity. [Experiment made with two flat flames of air burning in the atmosphere of coal-gas close to each other, the result being a luminous flame where the thin sheet of gas was hemmed in between the two strata of burning air.]

Finally, allow me to direct your attention to a source of great loss of light in the burning of gas, as usually carried out, and which is, perhaps, unavoidable. I allude to the loss of light which results from the use of glass shades or chimneys which are employed to surround the gas-flame. For instance, the loss of light from even the most transparent glass is estimated by Dr. Letheby—to whom I am indebted for the following table—as equal to 12 per cent.:

Loss of Light by Glass Shades.

	Loss per cent.
Clear glass	12
Slightly ground in pattern	24
Half ground	35
All ground	40
Opal glass	60

This fact ought to be taken into consideration in comparing the light of gas-flames with that of candles, because we do not require so to shade candle-flames to subdue their glare.

Shortly summarised, therefore, the conditions for obtaining light are—

1. The greatest amount of luminous vapour combined in the flame;

2. The retention of this vapour for the longest possible time in the flame;

3. The production of the highest possible temperature in the flame; and

4. The highest atmospheric pressure.

Three out of four of these conditions are within our control; the fourth evidently is not—we cannot control the pressure of the atmosphere, and it would probably be impracticable to burn coal-gas in an artificially compressed atmosphere in order to increase its luminosity.

We now pass on to a study of the chief constituents of crude coal-gas after passing the condensing apparatus, but before having its impurities separated. They are enumerated in this table:

Constituents of Crude Coal Gas.

Impurities.

Sulphuretted hydrogen.	Carbonic acid.
Carbo.-sulphur compounds.	Bisulphide of carbon.
Ammonia.	

Diluents.

Hydrogen.	Marsh gas.
Carbonic oxide.	

Illuminants.

Olefiant gas.	Propylene.
Butylene.	Acetylene.

Let us first consider the impurities of crude coal-gas. At the head of the list stands sulphuretted hydrogen, a gas formed by the combination of sulphur and hydrogen. Coals, even when of the best quality, contain a mineral which chemists call iron pyrites, which is bisulphide of iron. When hydrogen comes into contact with this compound, at a high temperature, it takes up a quantity of sulphur and becomes sulphuretted hydrogen. We have here some of this iron pyrites, and are passing a stream of hydrogen over it. By means of this test-paper, which has been immersed in a solution of acetate of lead, we can readily ascertain the presence of sulphuretted hydrogen. At present there is no trace of this compound in the escaping gas. We now heat the iron pyrites, and we find that long before it attains the temperature to which coals are exposed in the gas-retorts, its sulphur combines with the hydrogen to form sulphuretted hydrogen, which blackens the test-paper, the white acetate of lead being converted to the black sulphide.

Sulphuretted hydrogen is a colourless transparent gas, possessing a most disagreeable odour, which has been commonly compared to that of putrid eggs. Its specific gravity is slightly more than that of common air, being 1·171. One of its peculiarities is its property of discoloring paint. Almost all paint contains carbonate of lead, which is acted upon by sulphuretted hydrogen exactly in the same way as the test-paper I have been using to ascertain the presence of this gas. Here is a surface which has been painted with white-lead, and one half of it exposed to sulphuretted hydrogen. The other half has been exposed to the air; and as there is always a little sulphuretted hydrogen in common air, that half is also slightly discoloured. But you see that the half which has been exposed to sulphuretted hydrogen has been completely blackened, so that this gas is objectionable when it is present in the gas supplied to consumers. But I may remark that it is not present in that supplied by the gas companies in London; it, therefore, does not much concern us in dealing with the philosophy of gas-light. It burns with a blue flame, entirely destitute of light, and if not removed from the coal-gas would be a diluent.

The other sulphur compounds in crude coal gas are of much greater importance to us. The principal of these is bisulphide of carbon. Here is a specimen of it. It is a volatile, colourless, very inflammable liquid, of an insupportable odour, and boiling at 108° F. It is always present in coal-gas, but it is in excessive quantity in the gas delivered to consumers in London. It burns with a blue and lightless flame. We have, in fact, already used it for the production of an almost lightless flame when consumed in atmospheric air, but a flame which exhibits intense luminosity when consumed in oxygen. Its inflammability is such that it may be ignited by a glass rod simply warmed in a gas-flame. [Experiment shown.]

Now, several gases, when contaminated with bisulphide of carbon, become exceedingly inflammable, and capable of ignition at the low temperature at which the bisulphide itself ignites. For instance, if hydrogen, which requires a full red heat for its ignition, be mixed with a small quantity of the vapour of bisulphide of carbon, it will, when so contaminated, be ignited by a glass rod merely warmed in a gas-flame.

[Experiment shown.] In fact, at a temperature of about 400° F., this mixture of hydrogen and bisulphide of carbon vapour inflames. The same is the case with carbonic oxide if contaminated with this impurity.

Fortunately, however, for us, as consumers of gas, this property of easy ignition is not shared by coal-gas when so contaminated. The moment the least trace of coal-gas becomes mixed with the contaminated hydrogen the igniting point of the mixture rises to the igniting point of the gas before contamination. The slightest trace of olefiant gas produces the same effect. Thus, all danger arising from the admixture of bisulphide of carbon with coal-gas is removed by this curious property of coal-gas to raise the igniting point of bisulphide of carbon. The constituent of coal-gas to which this property is due has not yet been determined. One of the products of the combustion of bisulphide of carbon is sulphurous acid, which possesses powerful bleaching properties. I have here a red rose which I will hold over the the flame of bisulphide of carbon, and in a very few seconds the whole of its rich colour will be discharged by the sulphurous acid produced, and a mere ghost of a rose will remain. [Experiment performed.] Such is the action of the product of the combustion of bisulphide of carbon on many colours, and hence some of the disagreeable results attending the combustion of coal-gas as now manufactured in London in apartments which are not well ventilated.

ORIGINAL COMMUNICATIONS.

MR. E. T. CHAPMAN ON LIMITED OXIDATION.

On Limited Oxidation. *By* Ernest T. Chapman.*

With the view of proving that acids of the acetic series, even in the nascent state, are not attacked by bichromate of potash and sulphuric acid prepared as described in a previous paper,† the following substances were submitted to the action of this solution, and it was proved that the products theoretically obtainable from them, were obtained, and none others. The substances operated upon were—

1. Ethyl-alcohol.	9. Valerianate of amyl.
2. Amyl-alcohol.	10. Nitrite of amyl.
3. Iodide of ethyl.	11. Nitrate of ethyl.
4. Iodide of amyl.	12. Nitrate of methyl.
5. Iodide of isopropyl.	13. Ethylamine.
6. Acetate of ethyl.	14. Propylamine.
7. Acetate of methyl.	15. Amylamine.
8. Acetate of amyl.	16. Ethylamylamine.

I believe the whole of the above bodies were pure. It would be tedious to give the details of the examination of the acids produced in each instance. I will therefore give two examples only, viz. amylic alcohol and propylamine.

In the first instance amylic alcohol was digested for a short time with chromic solution. The products were—valerianic acid, valerianate of amyl and valerianic aldehyd; no carbonic acid. The same alcohol was digested for many hours with excess of the chromic solution, and the products distilled out. The distillate consisted of an oily and of an aqueous layer. It was neutralised with standard solution of caustic potash—when the whole of the oily layer disappeared. Enough sulphuric acid was now added to the distillate to combine with about a third of the potash which had been employed in neutralising—and the mixture distilled almost to dryness. Then, as much more acid was again added, and the mixture again distilled to dryness, the distillate being kept separate from the first distillate. Finally, excess of acid was added and the mixture again treated in the same manner. Now, as we know that the acids of the acetic series, excepting always acetic and formic acids, obey the following very simple rule with regard to displacing each other, viz. the higher members always displace the lower members from their combinations with bases, but acetic acid displaces them all. This rule holds good, at any rate, as far as caproic acid. It follows, therefore, that if any of these lower acids were produced, they would accumulate in the first distillate, and had any acetic acid been produced it would accumulate in the last distillate. Therefore, by proving that the acid in all three distillates was the same—and further, that this acid was valerianic acid, we should completely prove our point, viz. that valerianic acid is the sole product of the oxidation of amylic alcohol, and that valerianic acid, in the nascent state, resists the action of the oxidising agent. This proof is very easily obtained. It is only necessary to boil each distillate for some time with excess of carbonate of baryta, filter, evaporate the filtrates to dryness, and determine the percentages of barium contained in the dry residue. Treated in this way, the first filtrate yielded 40·31 per cent. of barium [mean], the second 40·28, and the third 40·27. There was, therefore, no perceptible difference between the three distillates, and as valerianate of baryta contains 40·41 per cent. of barium, no doubt can exist that the acid in question was valerianic acid.

The second instance that I shall give is that of propylamine. The propylamine employed was obtained by Mendius's method, namely, by the action of nascent hydrogen upon cyanide of ethyl. As this substance forms a link in in the alleged ascent of the alcohol series, and

* Third Communication. See page 112.

† This oxidising mixture I shall in future designate simply as chromic solution.

as, moreover, it is most probable that this ascent will be satisfactorily performed by the agency of alcoholic ammonias obtained in a similar manner, it is exceedingly important to prove that this compound is not an iso-propyl compound.

The propylamine was digested with chromic solution in the water-bath for some hours. On opening the tube a little gas escaped. This gas was proved to contain no carbonic acid. The contents of the tube were then partially distilled, and the acid distillate converted into a baryta salt, which salt, on analysis, proved to be pure propionate of baryta. With regard to the gas which escaped, I believe that it was nothing more than might be attributed to difference of temperature between the times of sealing and opening the tube. In fact, in another experiment, conducted in a similar manner, no gas escaped. Ammonia was found abundantly in the residue after both operations. From this it appears that propylamine is a normal propyl compound. Had it belonged to the isopropyl series it would have yielded acetic and carbonic acids. From these examples, and those enumerated, but not here described, we think the following inferences may be drawn:

First. That the oxidation product of a normal alcohol radicle is the fatty acid of the same carbon condensation.

Second. That in the case of compound ethers, such as acetate of ethyl, the alcohol radicle is oxidised, and that the acid residue, if I may call it so, is simply reconverted into the acid; for instance, acetate of amyl is converted into acetic and valerianic acids.

Third. That in the case of the compound ammonias the alcohol radicles are oxidised, and the ammonia left unacted upon.

Fourth. That, as before stated, the acids are unattackable in the nascent state.

As an example of the application to be made of the foregoing facts, I would bring forward the oxidation of ethylene, amylene and β hexylene. Ethylene yields carbonic acid and water only; amylene, 2 eq. of acetic acid, 1 of carbonic, and 1 of water; β hexylene yields propionic, acetic, and carbonic acids and water. From this we deduce that ethylene contains two groups, each containing 1 eq. of carbon; that amylene contains three groups or radicles, two containing two atoms of carbon, and the third one. β hexylene three groups, containing respectively three, two, and one atoms of carbon; and we therefore propose the following formula for these substances:

Ethylene.	Amylene.	β hexylene.
$\left\{\begin{matrix} CH_2 \\ CH_2 \end{matrix}\right.$	$\left\{\begin{matrix} C_2H_4 \\ C_2H_4 \\ C\,H_2 \end{matrix}\right.$	$\left\{\begin{matrix} C_3H_6 \\ C_2H_4 \\ C\,H_2 \end{matrix}\right.$

Assuming it to be proved that alcohol, amylic alcohol, etc., on oxidation, yield nothing but the corresponding acids, it follows, as a necessary consequence, that an amount of such acid, exactly equivalent to the amount of substance employed, will be produced, and that exactly the amount of oxygen requisite to convert the substance into the acid will be consumed. Quantitative estimations have been made with regard to both these points. The substances on which these quantitative experiments were performed were, alcohol, butyric ether, lactic acid, diethoxalic acid, and propione. The only reason for selecting these substances was, that they can all be obtained chemically pure, a statement which can be made concerning comparatively few organic bodies.

In my next communication I will describe the details of the quantitative processes.

LABORATORY NOTES.

A simple Water-bath.

In a recent visit to the Laboratory of London Institution we saw a somewhat peculiar water-bath in use. It consists simply of a common gallon can with a narrow neck, into which, by means of a bored cork, the stem of a funnel is fitted; in this funnel the dish containing the liquor to be evaporated rests. The can contains water, which is kept just boiling. The advantages of the apparatus, besides its extreme cheapness, are—that it will hold a very large volume of water, and therefore rarely requires replenishing, and that the evaporating dish rests on a perfectly clean surface of glass, a matter of some importance when the dish is to be weighed. Of course, from the shape of the funnel, dishes of various sizes can be used with the same apparatus. We have since seen a large apparatus made on the same plan, but supporting nine funnels. It is constructed of stout tin plate, and is 18 inches square and 10 deep. It is said to answer admirably.

PARIS UNIVERSAL EXHIBITION.

CLASS XLIV.—CHEMICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

Paris; *June* 3.

Paraffin and paraffin oil—Candles—Soaps—Parkesine. The incongruities of Class 44.

Young's Paraffin Light Company make a splendid display, which is, however, completely marred by the wall of carpets of which we have had to complain so loudly. Paraffin and paraffin oil occupy such a position amongst illuminating materials at the present day that it would be useless for us to enlarge upon their value here. The former beautiful body fulfils to the letter Liebig's great problem of obtaining "white, dry, solid coal-gas, portable and capable of being burned in a candlestick." The oil itself can be bought at such a price that the

poorest workman may use it with greater economy than the traditional farthing rushlight.

A glance at the Company's case will show the most casual observer that their beautiful manufacture is carried on upon truly scientific principles. Every product exhibited is described in such a way as to suit, not only the requirements of the ordinary exhibition *flaneur*, but also those of the scientific student. First we have two illustrative series of the products obtained from schist and boghead coal, which show tangibly the amount of each material obtained from them. The figures accompanying the series are interesting, as exhibiting the relative value of these two minerals.

Six kilos. of schist from the coal measures give—

Crude oil	1·065 litres.
Burning oil	0·468 „
Lubricating oil	0·092 „
Naphtha.....................	0·016 „
Paraffin	76·200 grammes.

Two kilos. of boghead mineral give—

Crude oil	1·065 litres.
Burning oil	0·446 „
Lubricating oil	0·089 „
Naphtha.....................	0·026 „
Paraffin	52·352 grammes.

It will be seen that, except in the case of the paraffin, six kilos. of schist yield somewhere about the same quantity of other products as only two kilos. of boghead mineral. Paraffin is exhibited in six stages of manufacture, from the crude material as it comes from the heavy oil to the hard white solid now so well known in all parts of the civilised world. There are also two specimens of paraffin shown which are to all appearance the same body, but whose melting points are 110° F. and 131° F. respectively. From certain experiments lately made by Mr. James Young, the father of this important manufacture, it would seem that the substance we know as paraffin is a mixture of several bodies, all having different fusing points. It is really singular how little attention this very interesting body has received at the hands of scientific men.

There are also illustrations of a means devised by Mr. James Young, junior, for utilising a large portion of the products of distillation which has hitherto been useless. We allude to that particular fraction of the distilled oil which is too light for lubricating purposes and too heavy for burning. This oil, which has a specific gravity of from ·880 to ·900, is put into a suitable still and distilled under a pressure of from one to two atmospheres, when there comes over a burning oil of a specific gravity of about ·825, whose vapourising point is 130° F. The remainder forms an excellent lubricant. The importance of this discovery may be estimated by the fact that the waste oil above mentioned forms nearly one quarter of the products of distillation.

Some curious details are given by the Company of the relative illuminating values of different materials. Thus, one pennyworth of solid paraffin will go as far as 2·84d. worth of wax, 1·162d. worth of ordinary composite, and 0·902d. worth of common tallow. Thus we see this beautiful substance is within a fraction as cheap as the commonest solid material used for burning. The comparison of paraffin oil with the above and other illuminants is singularly favorable. Still keeping solid paraffin as our standard, we find that while the same quantity of paraffin oil costs only 0·086d., London gas costs 0·092d., and Paris gas 0·141d. The heat and carbonic acid given off by paraffin and paraffin oil for the same quantity of light are much less than the amount generated by their congeners, as the following tabulated statement will show:

	CO_2.	Heat.
Paraffin oil..............	100	100
London gas	136	162
Paraffin candles.........	223	227
Sperm do.	276	284
Tallow do.	336	348

The specimens of burning oils shown are exceedingly beautiful. Some are almost colourless, and all have an inflaming point at or about 130° F., that being the limit of safety fixed by Mr. Tegetmeier and other authorities on the subject. There is one specimen of shale oil, which possesses all the properties of a perfect illuminant, whose inflaming point is as high as 178° F., proving that a low vaporising point is not a necessary property of a good burning oil.

As an illuminating material paraffin oil stands at the head of all others, or, at any rate, will do so until gas companies learn to cleanse their gas from sulphur compounds; but there is one fault connected with paraffin candles that will render their universal use impossible, and that is their tendency to gutter and run if carried about. This appears to be caused by the extreme limpidity of paraffin in the melted state. With the exception of wax, solid illuminants seem to possess this fault in direct proportion to their hardness, and there is no comparison between the convenience for carrying about of the old-fashioned tallow mould and the newer stearine and paraffin candles. Not only this, the excessive limpidity of the melted paraffin apparently causes it to become vaporised much sooner than other materials of a similar character, consequently the flame begins so near the melted paraffin that no inconsiderable quantity of the downward light is obscured by the cup. Is there no means of reducing this tendency to limpidity in paraffin by the admixture of some other substance?

Some interesting specimens of the numerous applications of paraffin are also shown in the Company's case. Amongst the most important are the application of this substance to the formation of splints, first suggested by Drs. Kirk and Tait. Flannel is dipped into melted paraffin of a low melting point, and when just setting it is wrapped carefully round the broken limb. It solidifies almost immediately, forming a firm, light, and non-absorbent splint. Its application to the preservation of meat by Professor Redwood is also shown, but as the professor's own display has yet to be described we can do no more than mention it incidentally. Dr. Sten-

house's method of waterproofing cloth by means of paraffin is also shown, as well as illustrations of its more homely value as a substitute for sulphur in making lucifer matches, and as an addition to starch for laundry purposes.

There are several other exhibitors who show paraffin oil, paraffin and stearic acid candles, but their displays, although excellent in themselves, present no points of scientific interest. There are two beautiful specimens of crystallised palmitic acid in the case belonging to Price's Patent Candle Company, who, in addition, exhibit pure glycerine of the finest quality. It is perfectly free from even the slightest empyreumatic odour or taste, praise that cannot be bestowed on most samples of glycerine that come into the market from foreign sources. It is somewhat out of our province to notice toilet soaps, but this firm shows some specimens of glycerine combined with soap in the proportion of 50 per cent. of each ingredient, which seems to indicate that the alkaline stearates and their allied salts are soluble in glycerine. The mixed soap and glycerine is in the form of translucent cakes.

The show of common soaps is very good, most of our first-rate London firms having sent contributions. Mr. Gossage exhibits some specimens of silicated soap, containing a certain amount of silicate of soda, which is practically found to be as effectually detersive as fatty and resinous acids in combination with an alkali. Singularly enough, some of the foreign jurors seemed to regard the introduction of resin and silicate of soda into soaps as an adulteration, and we hear that it took some little trouble to convince them to the contrary.

Messrs. Cook and Sons' display is remarkable for the illustrative specimens it contains. An instructive series, showing visibly the proportion of the constituents existing in ordinary soaps, is another instance of the good sense that so many exhibitors have shown in giving a scientific interest to their collections. The following comparative table will present many facts worthy of notice by those of our readers who take interest in the fatty acids and their combinations:

Best Yellow.		Best Mottled.	
Tallow acids	50·00	Bone-tallow acids	62·40
Water	31·50	Water	30·00
Caustic soda	6·50	Caustic soda	7·60
Resin	12·00		
Marine.		**Blue Mottled.**	
Cocoa-oil acids	23·00	Palm and cocoa-oil acids	50·00
Water	59·60	Water	41·20
Caustic soda	2·70	Caustic soda	7·30
Chloride of sodium	14·70	Salts	1·80

Why cocinate of soda should take up such an enormous quantity of water in comparison to the soda salts of the other fatty acids still remains a mystery—one of the many that are daily puzzling our manufacturers, but which they have no time, and scientific chemists apparently no will, to investigate. It is to be feared that most of our younger chemists of the present day are only too anxious to discover new substances instead of examining old ones, about which we know so little. Why do they not follow the good example set them by Dr. Frankland and numberless other men of eminence, and descend from their polyammoniacal pedestals for awhile and investigate some of the compounds that exist under their very noses?

Messrs. Petman and Muller show an article which they state to be "Wax Soap." They also say that it is "free from *resin* and *other* deleterious substances." We beg to demur to both these statements. If the soap be really made of wax we should be glad to know the advantage of using so expensive a material, and we never heard of the presence of resin in soap being regarded as deleterious by any one but Messrs. Petman and Muller. At the bottom of their case are several bottles covered with blue mould, and said to contain the substances from which the soap is made; but as they are without labels we are as much in the dark as if they had never been exhibited. The soap, whatever it may be made of, is a dirty looking compound.

Mr. Alexander Parkes exhibits a wonderful series of specimens illustrating the uses to which that peculiar substance now known everywhere under the name of *parkesine* may be applied. As most of our readers possibly know, it is made by combining castor or cotton-seed oil with pyroxylin dissolved in a mixture of ether and alcohol, nitrobenzol, or some other suitable solvent. The combination of the oil and the pyroxylin gives rise to a substance of uncertain composition, which is applicable to an infinite number of uses. It is as hard and flexible as ivory; it is neither softened by heat nor hardened by cold. It may be rolled in a press or struck in a die; it is capable of receiving almost every colour, both opaque and transparent; it has several solvents, and can be made in transparent plates as hard and flexible as horn. It is a strong elective, and has been found to be superior to both india-rubber and gutta-percha for insulating purposes. In fact, it seems difficult to say to what uses it may not be turned. It was first exhibited, in the infancy of its discovery, at the Exhibition of 1862, attracted an immense amount of notice, and gained a prize medal; but since that time its inventor has been so much occupied with several other inventions of his fertile brain, that it is only within the last few months that its commercial manufacture has commenced. Mr. Parkes has kindly consented to open the doors of his factory to one of our staff; we shall, therefore, say little more on the subject. His case has been the object of everybody's admiration, from the young ladies who think parkesine fans, paper-knives, and card-cases, amongst the prettiest things in the Exhibition, down (or up?) to the grave scientific men from all parts of Europe, to whom it presents another interesting puzzle in chemistry.

There are many other objects exhibited in Class 44 which we feel hardly called upon to notice. In the system of classification adopted by the French Commission there seems to be an overweening tendency to classify objects rather according to their origin than to their ultimate use. In many cases this rule is broken through, the consequence being that several manufacturers exhibit the same manufactures in two different classes. For instance, india-rubber goods are classed along with soda, quinine, and soap, they

all being considered chemical manufactures, a system that brings candles, mackintosh coats, kamptulicon knifeboards, and blacking, within sight of each other. A natural classification of manufactures is, of course, impossible, and we are compelled to fall back on the use to which an object is put, or the particular branch of manufacture to which it belongs, as our guide in arranging them; but surely a compromise might be made between these two principles, and the absurdity avoided of giving a scientific chemical jury waterproof coats, kamptulicon floorcloth, india-rubber combs, vulcanite bracelets, blacking, and such like incongruities.

EDITORIAL NOTES.

CHEMISTRY OF THE PRIMÆVAL EARTH.

DR. PAUL, in an admirable article on the Chemistry of Geology, contributed to 'Watts's Dictionary,' remarks—"it is from chemistry alone that data can be obtained which will admit of correct conclusions being formed as to many geological phenomena, such, for instance, as the formation and alteration of rocks and strata, and of the individual minerals of which they are constituted." Those geologists who attended Mr. T. Sterry Hunt's lecture at the Royal Institution on the 31st ult. must admit that geology is dependent upon chemistry, and that any theory of rock formation in which chemical action is disregarded must be imperfect. Though Mr. Hunt's history of our planet was based upon actual results obtained in the laboratory, it may doubtless have appeared to many as the dream of a poet rather than the rigid expression of positive science. Starting with the theory that what is now the world was once an intensely heated mass of gases and vapours—which theory accords with the recent revelation of the spectroscope—Mr. Hunt showed that the rocks constituting the earth's crust have naturally resulted from the gradual cooling of this mass and the play of chemical forces at different temperatures. The primæval earth, formed by the cooling of a magma of silicates and aluminates, was sursounded by an atmosphere of enormous density, consisting of carbonic, hydrochloric, and sulphurous acids. Under the pressure of such an atmosphere water might exist in a liquid state at a very high temperature. This water would dissolve the condensed acids, and would attack the rocks, the primary result being an accumulation of chlorides and sulphites; at the same time the carbonic acid of the atmosphere would attack the dry surface, forming carbonates. By the reaction of these salts the primitive limestones, dolomites, and gypsum, together with the chloride of sodium present in the ocean, were produced. The leading results of Mr. Hunt's experiments have already been noticed by our Paris correspondent,* and as we hope to publish a lengthy abstract of this lecture in a future number, we will not attempt to reproduce the whole argument.

INDUSTRIAL EDUCATION.

LORD GRANVILLE, the President of the Committee of Council on Education, writing to the 'Times,' refers to "the superior progress made in machinery by foreigners," and to "the little advance we have made in most departments of industry, except in those of furniture, glass, and china." In support of his general assertion he publishes a letter addressed by Dr. Lyon Playfair to Lord Taunton, to which we shall presently refer. It is a noteworthy fact that the Science and Art Department, presided over by Lord Granville, has taken under its special care those branches of industry which are so inadequately represented at the Paris Exhibition. We, at any rate, hear of examinations being held and rewards given for proficiency in "mechanical and machine drawing," and in "steam;" and the South Kensington syllabus leads us to suppose that those who pass these examinations must have a practical knowledge of the construction and application of machinery. On the other hand, in the departments of furniture, glass, and china, where we hold our own against the foreigners, we owe little to South Kensington beyond the occasional display of good examples in loan collections. It is well to keep this fact in mind, as it bears on some of the remarks we have to make.

According to Dr. Playfair, the eminent men of different nations congregated on the international juries in Paris have come to the conclusion that our country has shown little inventiveness, and made but little progress in the peaceful arts of industry since 1862; and they seem to be agreed as to the primary cause of our stagnation. While France, Prussia, Austria, Belgium, and Switzerland, possess good systems of industrial education for the masters and managers of manufactories and workshops, benighted England possesses none. We cannot accept this as the true cause of the inferiority of our display of machinery at Paris, and we are surprised that Lord Granville should appear to endorse the opinions of the foreign jurors, while the department over which he presides has already sixty-two certificated science-teachers in "mechanical and machine drawing," and twenty-one in "steam," scattered throughout those districts where the machine manu-

* Pp. 77—120.

facture is mainly carried on, and offers prizes of no small value to those who pass its examinations. Are we really behind our foreign neighbours in those branches of industry in which, until so very lately, we took the lead? Are these branches properly represented at the Exhibition? Many of our principal machinists have not exhibited. They, in common with others whose manufactures are expensive and cumbersome, have neglected to send in their works, being, probably, tired of these great Exhibitions which succeed one another so rapidly, and having learnt the true value of the distinctions which they offer. The prize medal may be of use as a trade advertisement to dealers in smaller wares, but the position of these non-exhibitors is too high to need such recommendation. A joke too often repeated becomes wearisome.

Dr. Playfair evidently thinks that some system of "technical education" should be introduced into this country to enable us, if not too late, to recover the vantage-ground which he says we have lost. We admit that extended scientific and industrial teaching is desirable, but we doubt whether any foreign system would thrive in this country. The feeling of the English people is against Government control in educational matters. Our indigenous system is capable of great development, and need not be supplanted. By strengthening with Government assistance the numerous colleges already in existence, and by establishing others on similar principles, the scientific and industrial education of Englishmen may be carried out to any extent. We certainly should object to the delegation of increased powers to a body of whose existence two thirds of the people are ignorant, and of whose capabilities for directing national education the learned entertain serious doubts—a body which is nominally associated with Science and Art, but which has as yet done little to advance either.

One question to Dr. Playfair before we conclude. Did the power-loom and the steam-engine originate under a Government system of industrial education? The peaceful development of mechanical science has been independent of Government assistance, and has resulted from the strong unaided energies of individual Englishmen, mostly of the humbler classes. It is wrong to ignore this great fact, and to speak as though we were unable to continue to build upon the solid foundation we have so firmly laid.

Dr. Playfair suggests that there should be a Government inquiry into industrial education on the Continent, in order to ascertain the means by which the "great States" are attaining an intellectual pre-eminence, and the conditions under which their national industries are making such rapid progress. In our humble opinion such an inquiry would be profitless.

Before considering the systems of industrial education adopted by the "great States," our Government ought to look at home, and inquire into the system which is being carried out by the Department of Science and Art. Authentic information respecting this institution is much needed. With what powers is it invested? What are its intentions? To whom is it responsible for the proper discharge of its functions?

When such questions have been plainly answered by a Government Commission of Inquiry, Dr. Playfair's suggestion may be deemed worthy of adoption.

A CHEMICAL REPORT ON WINES.

The long string of titular letters which Dr. W. Bird Herapath, of Bristol, writes after his name must be regarded with envy by unlettered dealers in testimonials. The letters F.C.S. have often formed a respectable trading capital; but a chemist who is entitled to make use of the letters M.D., F.R.S., M.R.C.S.E., and L.S.A., has the advertising world at his feet. The chemical report which Dr. Herapath has prepared as an advertisement for the Victoria Wine Company may deceive the general public, but every analytical chemist will regard it as a puff, pure and simple. The wines, though sold as low as one shilling per bottle, may be as pure as they are said to be, but the figures in Dr. Herapath's table do not indicate their quality. Any ingenious cellarman could concoct a wine, innocent of the juice of the grape, that would yield the same numerical results. Chemistry affords very little useful information as to the purity of wines. Of course, Dr. Herapath knows this, and we do not suppose that he would willingly exchange the forty-eight-shilling port in his own cellar for the twelve-shilling port which, according to his table, resembles it so closely. He publishes the numerical results of his analysis in order that would-be consumers of the cheap wines he recommends so strongly "may see and judge for themselves." Left to themselves, most people will conclude that there is no essential difference between the "pure, unadulterated, genuine wines" of the Victoria Wine Company at a shilling a bottle and the high-priced wines taken from the doctor's cellar. The more knowing ones will conclude that there is no essential difference between Dr. Herapath's elaborate report and an ordinary tradesman's puff.

LITERATURE.

BRANDE'S DICTIONARY.

A Dictionary of Science, Art, and Literature. Edited by W. T. BRANDE, F.R.S.L. and E., and the Rev. G. W. COX, M.A. Fourth Edition. In Three Volumes. London: Longmans, Green, Reader and Dyer.

WE welcome with much pleasure the appearance of the fourth edition of Dr. Brande's excellent book of reference. This dictionary has an identity and distinctive character peculiarly its own, which marks it out from all its compeers and predecessors. It is the most compact, condensed, and original *résumé* of knowledge we possess in the English language, and, so far as our researches have extended, we know of no work in German, French, or Italian, to match with it. Unquestionably there are large encyclopædias in those languages equal, at the least, to the best of ours; but neither abroad nor at home is there any systematic digest of science, art, and literature so portable, so facile of reference, as the one before us.

The plan of the projector, Dr. Brande, cannot be too highly commended. When he contemplated the publication of this book, now more than a quarter of a century ago, he adopted the very best means to obtain the greatest amount of accuracy and excellence for his undertaking. He adopted the plan of distributing his work into divisions, each embracing a single subject, or a class of closely allied subjects, assigning these to gentlemen distinguished for their proficiency in the departments committed to their care. By this method the shorter, and, according to the plan of some encyclopædial editors, the less important words were placed under the charge of men of the highest ability in their several walks. He did not seek to make his work attractive by securing a few brilliant treatises, to set like gems in a heavy mass of mere compiler's work. His aim was to avoid a mere re-casting of what other encyclopædias contained, and to obtain an original digest of the stock of knowledge possessed by the world at the date of the publication of his book. The mode of publishing treatises long enough of themselves to form a considerable work causes the encyclopædias in which they are incorporated to assume such voluminous proportions as to place them quite beyond the reach of ordinary readers. What we mostly want is a book which shall furnish within a moderate compass a body of authentic information upon science, literature, and art, so arranged that the utmost facility of reference may be afforded to the reader who has occasion to consult it. Now, the extensive plan upon which encyclopædias are compiled entirely leaves this object out of view.

It is a somewhat curious fact that our encyclopædias, now so voluminous, were at the outset of their history volumes sufficiently compact and concise. The manner in which they have grown to such bulky proportions we do not regard as an advance upon the original plan. They have gone on, edition after edition, increasing in size, and consequently in price, without bestowing upon the general body of the small hard-working words, so to say, any more attention than these received at the commencement of their career as encyclopædial definitions. Howsoever we may regard it, this neglect of the so-considered smaller words, in order to secure greater prominence for the labours of a few distinguished writers, is not a decided advantage to the work which is built upon such a foundation, for the important and valuable treatises on science thus published are very often behind the existing state of knowledge when their parent work is completed. Clearly the most judicious plan is to make oneself the possessor of a comparatively small, but in reality very full, dictionary, such as the one in question; leaving to the manuals which emanate at the proper time from the pens of authorities in science and art, the office of placing before us the newest ideas relative to the subjects upon which they treat.

This notion of bulkiness and high price is of comparatively modern introduction. The historical dictionary of Moreri, who killed himself by his work, was a portable book enough; the first English cyclopædia, the 'Lexicon Technicum, or Universal Dictionary of Arts and Sciences,' by John Harris, was in two volumes; the 'Cyclopædia' of Ephraim Chambers was also comprised in two volumes; the 'New Universal Dictionary of Arts and Sciences,' by John Barrow, was in one large folio volume; the 'New and Complete Dictionary of Arts and Sciences,' written, according to the title-page, by a "Society of Gentlemen," and usually styled, after the name of its publisher, 'Owen's Dictionary,' was in four octavo volumes; the earliest edition of the 'Encyclopædia Britannica,' which first appeared ninety-six years ago, was in three quarto volumes of not large dimensions. The work which it is said suggested the last-named encyclopædia was the 'Universal History of the Arts and Sciences,' published in London in 1745 by a certain Dr. Coetlogon, which was mainly composed of complete treatises on distinct arts and sciences. In proceeding after this fashion it were pretty much as though at a future period—say when the copyright had lapsed—we were to take the several treatises included in 'Lardner's Cyclopædia,' and string them upon a thread of short definitions of words selected from the lexicon nearest to hand. While upon the subject of lengthiness in works of reference, we may congratulate ourselves upon never having gone so far as the Germans, whose 'Oekonomisch-Technologische Encyklopädie,' commenced at Berlin in 1773, and now in progress, has attained the respectable number of 220 quarto volumes. As a set off, however, against this encyclopædial monster, they may show their admirable 'Conversations-Lexikon,' the last edition of which was comprised in fifteen volumes—a work of unequalled popularity.

We spoke of 'Brande's Dictionary' as being characterised by originality, an epithet which may, perhaps, need a few words of explanation. When the work first appeared every word was compiled from original sources, not founded upon other encyclopædias, which feature the work still retains, thus giving it an advantage over even the ambitious

'Encyclopædia Britannica,' the shorter definitions in which are founded upon earlier works of the same class as itself. The supposed necessity for such a groundwork has long been in fashion. The celebrated French 'Encyclopédie' was built up in this way. When the cyclopædia of Ephraim Chambers appeared it was reviled in France as a servile compilation, principally from French writers; nevertheless Diderot and D'Alembert confessedly took a translation of this work as the foundation of their own. They made the curious admission that otherwise it would have been almost impossible to procure the necessary assistance for the task:—"Il n'y a," they said, "presqu'aucun de nos collégues qu'on eût déterminè à travailler, si on lui eût proposer de composer à neuf toute sa partie; tous auroient été effrayés, et l'Encyclopédie ne se feroit point faite."*

After the publication of the earlier edition of 'Brande's Dictionary' it was the practice to issue a supplement containing terms that had been omitted, or that appeared on further reflection to deserve a place in a 'Dictionary of Science, Art, and Literature;' as also the principal scientific terms which had come to be adopted since the first edition. The prospectus to the present edition informed us that "the progress of science and general knowledge during the twenty-four years which have elapsed since the publication of the first edition of this dictionary has made it impracticable any longer to render that work a fit representation of existing knowledge by means of corrections and supplements. It has, therefore, been considered advisable to re-write or re-edit it throughout, and thus to make it an entirely new work." The general reader who desires to get his information readily, and the student whose list of books to master is considerably longer than his purse, will be grateful for the enterprise which has enabled the editors to put in execution the laudable intentions announced in the paragraph we have quoted. On the principles just mentioned the work has been mainly re-cast and re-written.

The rapid progress of Comparative Anatomy has compelled the introduction of a large number of new words. The valuable discovery of interesting general forms of life has given rise to their description in a series of new articles, comprised under the section of Zoology; the advance made in the science of Palæontology required and received increased attention; in Geology, what was in former editions a long general article has been disintegrated, and the subject has been, we think, advantageously broken up into the several branches into which the science is divided; Physical Geography makes its appearance almost for the first time in this edition; the application of photography to the production of permanent records of celestial phenomena, and the new views inaugurated through the means of spectrum analysis have all been concisely but surely noted under the department of Astronomy. We are assured by the editors, and there is abundant proof of the assertion, that the necessity for a thorough revision of the articles on Chemistry and Physics has been met, and that much new matter has been added; the like remark applies also to Mineralogy. In the subjects of Architecture, Mathematics, Agriculture, the Military and Naval Sciences, in Political Economy and Theology, the articles of the former editions, being found far below the present standard, have been carefully rewritten. One feature in this fourth edition of 'Brande's Dictionary' is almost entirely new—the descriptive articles bearing upon the subject of Comparative Mythology, which, when the first edition of the work was published, about twenty-five years ago, was scarcely in existence. Upon the subject of Derivations, or Etymology, the editors seem to have proceeded in the most praiseworthy way. Without desiring to be exhaustive, and leaving, very properly, the task of tracing words to their original source to the professed philologist, their aim has been to give the nearest forms in which any word occurs in languages to which it has the closest relationship.

Many changes have been necessitated in the list of editors and contributors to the dictionary; the most important is that due to the death of the lamented Professor Brande, whose clear and energetic mind was engaged upon the work almost till the last days of his earthly career. The original edition was produced under the editorship of Professor Brande, with Dr. Joseph Cauvin as his assistant. The book now before us was completed by the Rev. G. W. Cox, M.A., who commenced as assistant-editor under Dr. Brande. Botany and Gardening, originally from the pen of Dr. Lindley alone, now owes a portion of its matter to Thomas Moore, F.L.S., Curator of the Botanic Garden, Chelsea; the Biolological sciences, comprising Anatomy, Physiology, Zoology, and Palæontology, are still confided to the care of Professor Owen, who is assisted by Dr. C. Carter Blake.

At first, Chemistry, Mineralogy, Geology, Medicine, and the Arts and Sciences depending on chemical processes, were all undertaken by Professor Brande. Very properly these subjects are no longer entrusted to one pen, but are distributed amongst a number of able contributors: General Chemistry and Physics owe their exposition to Professor Brande, Dr. Frankland, John Attfield, Ph.D., John Broughton, B.S., W. F. Barrett, and Herbert MacLeod. Geology, Physical Geography, and Hydrology, emanate from Professor Ansted; whilst Mineralogy comes from Henry William Bristow. Political Economy, formerly contributed by J. R. McCulloch, is in this edition confided to the Rev. J. Thorold Rogers. Astronomy is under the charge of Dr. Frankland and J. N. Lockyer. The section relating to Agriculture has been written by John Chalmers Morton, the editor of the 'Agricultural Gazette.' General Literature is from the Rev. G. W. Cox and Herman Merivale, the latter gentleman, in this edition, as in the first, taking the division of the work relating to Law.

The foregoing list of names of the eminent gentlemen who have contributed to this new edition will form a sufficient guarantee for the worthiness of the work. In the former editions the print was painfully small; we are glad to observe a great improvement in this respect, for now we have a larger and exceed-

* 'Encyclopédie,' art. "Encyclop.," tom. v, p. 645.

ingly readable type. It may appear hypercritical, but in reality it is not so, to find fault with the binding of the book. It is defective in this respect, because too fragile and flimsy for so weighty a work. The constant reference to which these volumes will be subjected will soon cause the sheets to jump out of their covers, and then the re-binding will necessitate the abridging of the margin, already rather deeply cut into by the bookbinder's "plough;" but luckily for the reader, he has the remedy in his own hands; he has only to purchase an edition of the work bound strongly in half calf to possess a good, lasting, wear-and-tear edition of a valuable book—a work wherein no difficulties have been evaded, but have been fairly met and overcome; the most commendable book of its kind we know, the most excellent review of the entire field of human knowledge we at present have in the English language.

ANALYSIS OF THE METROPOLITAN WATERS IN MAY, 1867.

By Professor FRANKLAND, F.R.S., *of the Royal College of Chemistry.*

1. Companies.	2. Date and Place of Collection.	3. Total solid impurity in 100,000 parts.	4. Organic Carbon.	5. Nitrogen, as Nitrates and Nitrites.	6. Ammonia.	7. Total combined Nitrogen.	8. Previous Sewage Contamination. (Estimated.)	9. Total Hardness.
Thames.								
Chelsea	1st May, Cab Rank, Horse Guards	29·34	·287	·199	·004	·231	1325	22·0
West Middlesex	1st May, Great Portland Street, W.	27·16	·231	·220	·004	·274	1755	20·8
Southwark & Vauxhall...	1st May, Barclay's Brewery	28·82	·260	·207	·006	·278	1795	20·8
Grand Junction.........	30th May, Cab Rank, S. Molton Street	29·84	·278	·210	·005	·228	1295	21·4
Lambeth......	1st May, Cab Rank, Westminster Rd.	29·64	·465	·184	·006	·227	1285	21·4
Other Sources.								
New River...	15th May, Cab Rk., Tottenhm. Ct. Rd.	24·68	·163	·205	·004	·285	1865	18·8
East London	7th May, Old Ford Waterworks	26·86	·245	·161	·002	·190	915	20·0
Kent	14th May, Waterworks, Deptford	39·22	·254	·363	·002	·384	2855	28·0
Loch Katrine	February, Glasgow	3·28	·256	·031	·002	·041	0	0·3

The numbers in columns 3, 4, 5, 6, 7, 8, and 9, all relate to 100,000 parts of the waters. The Table is to be read thus:—100,000 lb. of Chelsea water collected on 1st May at the Horse Guards cab rank contained 29·34 lb. of solid impurity; the organic matter, constituting a portion of this impurity, contained ·287 lb. of carbon. This solid impurity also contained ·199 lb. of nitrogen in the form of nitrates and nitrites, besides ·004 lb. of ammonia, whilst the total amount of *combined* nitrogen in every form was ·231 lb. The above quantity of water supplied by the Chelsea Company had been, after its descent to the earth as rain, contaminated with sewage or manure matter equivalent to 1325 lb. of average filtered London sewage. By gradual oxidation, partly in the pores of the soil, partly in the Thames or its tributaries, and partly in the reservoirs, filters, and conduits of the Company, this sewage contamination had been entirely converted into comparatively innocuous inorganic compounds before its delivery to consumers. Finally, 100,000 lb. of the Chelsea Company's water contained 22·0 lb. of carbonate of lime, or an equivalent quantity of other soap-destroying ingredients.

The waters of the Southwark and Grand Junction Companies were turbid when drawn from the mains.

The water supplied by the East London Company from their reservoirs at Old Ford has been specially examined for *present sewage contamination* (i. e. sewage existing as such at the time the analysis was made), but no such contamination was detected.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *June* 3.

Death of Pelouze—His life and work—Vacancy in the Academy—On some faults in the election for places—Foundation of a physical laboratory—Meeting of the Academy of Sciences on May 27.

THÉOPHILE JULES PELOUZE, whose severe illness we mentioned a fortnight ago, died on Friday last, the 31st of May, at his country house at Bellevue, close to Sèvres. Born the 13th of February, 1807, at Valognes (Département de la Manche), he inherited his love for science and arts from his father, Edmond Pelouze, a man of great practical talents, formerly employed in the manufactory of Gobelins, and afterwards director of the gasworks of the Manby and Wilson Company at Paris. Pelouze the elder is known as the author of a great number of treatises on various branches of applied chemistry—on glass-making, on brickmaking, on colours and varnish-making, on washing and bleaching for housewives, etc. His treatise on the last-named subjects was published under the name of his wife. His chief work, 'On the Manufacture of Gas,' was revised by his son, and came out in a second edition as late as 1859.

Young Pelouze entered life as a pharmaceutical chemist; but he was only twenty years old when Gay-Lussac made him his assistant, and published some of his researches conjointly with him. Three years later, in 1830, he became professor of chemistry at Lille. Here he examined the juice of beetroot, and, in conjunction with Kuhlmann, published a paper on its fermentation. From 1831 until 1847 he took the place of Gay-Lussac as Professor of Chemistry at the École Polytechnique, and at about the same time (1831) he was elected to supply the place of Thénard as professor at the Collége de France.* Shortly after these elections Pelouze managed to go to Giessen, and to publish joint researches with Liebig on the ether contained in wine, to which they gave the name of œnanthic ether, but which was afterwards proved by Delffs to be identical with pelargonic ether.. In 1833 Pelouze became Assayer, and in 1846 Controller (Vérificateur) of the Mint. He was elected a member of the Académie des Sciences in 1837. Of republican views, and much interested in politics, he became prominent through the revolution of 1848. The provisional government elected him to a place which until then belonged to the nobility or to the chief dignitaries of the state, that of President to the Board of the Mint (Président de la Commission des Monnaies). This position he held until his death. He became successively knight, officer, and commander of the Legion of Honour. His private laboratory for pupils in the Rue Dauphine closed when he opened a laboratory in the mint. The number of papers published by the deceased is very great. We can only mention here the most prominent of his researches. Among these none will be better remembered than the investigation recorded in his paper on the transformation of hydrocyanic acid into ammonia and formic acid. This paper was published in 1834, but the importance of his discovery became evident at a much later period, when hydrocyanic acid was first produced from carbon and nitrogen. Then it was that the transformation which Pelouze had effected by treating hydrocyanic with a strong solution of hydrochloric acid attained its remarkable position as the first instance of the synthesis of an organic body from its elements. At the time of the discovery its real importance could not be appreciated, but even then the relation of formic to hydrocyanic acid was of much interest. Next in importance to this memorable paper are several papers on the products of the dry distillation of lactic, malic, and tartaric acids. Pelouze discovered lactic anhydride and lactide. Maleic and pyrotartaric as well as pyrogallic acid, if not actually discovered were, at least chiefly studied by him. The salts of lactic acid were likewise examined by Pelouze, and described in several papers, one of which he published conjointly with Gay-Lussac.

A memoir on mustard oil was published by Dumas and Pelouze; another on asparamide (asparagine) and asparamic acid by Pelouze and Boutron, and a joint research on curarine was published by Pelouze and Claude Bernard. In mineral chemistry nitrosulphuric acid constitutes his chief discovery. In applied science numerous contributions, particularly on fulminates and the manufacture of percussion-caps, and above all on glass, were published by him at various intervals. Pelouze had an interest in large glass works at St. Gobin, and his last communication made to the Academy, some months ago, treated on the subject of this manufacture. A treatise on chemistry in five volumes by Pelouze and Fremy has seen three editions, the last of which was published in 1866. All these publications, if they do not place him amongst the very first French savants, will preserve his name permanently in the history of science. His great kindness of heart, and sincere and active interest for his pupils, will not easily be forgotten. There are and have been witnesses to these genial qualities in England. Professor Crace Calvert and the late Mr. Stoikowitch were assistants to M. Pelouze. During the last years important researches on aniline colours were carried on in his laboratory by MM. Girard, de Laire, and Chapoteaut.

Pelouze outlived his wife some weeks only. He leaves a son and two daughters. His death opens a place in the chemical section of the Academy, where no election has taken place since Thénard died in 1857. Some months will pass before a new election will provide a successor to the deceased academician, but already the result might be predicted with great probability. A change will most likely take place in the arrangement of offices in the mint. Other vacancies do not occur through this death, for Pelouze, with great self-denial, voluntarily abdicated

* It is usual in some public schools of France that a professor may give up his work without losing either his title or his salary. The man who takes his place is called "professeur suppléant," and stands in the same position to him as a curate would to an incumbent in the Church of England. This is the way in which Pelouze acted for Gay-Lussac and Thénard.

his several professorships. Such self-denial is not often practised by the scientific men of France. I could name several eminent professors, each of whom holds about half a dozen snug little places. As a rule, professorships in science here, as in England, bring inadequate pay, and this is the reason, but not always the excuse, for the accumulation of offices. Having touched upon one evil connected with professorships, I venture to call attention to another, which is common to both countries. I allude to the tendency to give the preference to candidates who have been pupils to the institution where the vacancy occurs. A flagrant example of this occurred here a short time ago, when the place of Répétiteur to the Polytechnic School was given to a former pupil of this institution, perfectly unknown, in preference to a professor of the highest attainments and reputation.

A great step in advance for the promotion of physical science is contemplated at present by the professors of the Sorbonne. It is intended to found a laboratory for researches in natural philosophy, and to place it under the care of Professors Jamin and Desains. Similar institutions on a limited scale exist, as far as I know, in Germany only, at Heidelberg with Professor Kirchhoff, at Königsberg with Professor Neumann, and at Berlin with Professor Magnus as directors.

I now turn to the meeting of the ACADEMY of 27th ult.

How have native metals been reduced from their combinations? To solve this question Professor Graham has made a great step by inquiring into *the nature of the gases enclosed in malleable and colloid metals*, such as meteoric iron. For these gases will indicate the nature of the atmosphere which surrounded the metals when for the last time they were in a soft state. The meteoric iron from Lenarto being very pure and malleable, containing in 100 parts 90·9 Fe, 8·4 Ni, 0·7 Co, and a trace of copper), was considered to be particularly well suited for this inquiry. A piece of 45 grammes was cut off with a chisel and washed with potash and distilled water, care having been taken to ascertain that this treatment does not cause hydrogen to be absorbed by the iron. The piece was then heated in a new porcelain tube, the air of which was first removed by Sprengel's aspirator. In two hours and a half 16·5 cubic centimetres of gas were evolved, the second portion of which, on examination, was found to consist of 85·7 p.c. of hydrogen, 4·4 p.c. of carbonic oxide, and 9·8 p.c. of nitrogen. The quantity of gas evolved corresponds to 2·85 times the volume (5·78 c.c.) of the iron. A comparison was then instituted by treating in the same way 23 grammes of iron nails (well cleaned). They disengaged 7·98 c.c. of gas, or 2·66 times their own volume. The second part of this gas consisted of 21 p.c. of hydrogen, 58 p.c. of carbonic oxide, and 11 p.c. of nitrogen. The terrestrial origin of this iron thus becomes evident through the large amount of carbonic oxide it contains. On the other hand, through spectral analysis, hydrogen has been discovered by Messrs. Huggins, Miller, and Secchi in many fixed stars. The iron from Lenarto evidently owes its origin to a similar atmosphere. It contains imprisoned in its pores the hydrogen of stars. But as iron under ordinary pressure could never be made to absorb more than its own volume of hydrogen, whereas the iron of Lenarto contains three times as much, the density of the star-atmosphere was evidently much greater than our own, and particularly much greater than the thin atmosphere of comets.

M. Desains, in his researches on the *absorption of heat by liquids and gases*, obtained the result that a substance has the same power of absorption in the gaseous and in the liquid state. Thus, a tube filled with liquid ether, and another tube of the same section filled with vapour of the same weight of ether, at little less than ordinary pressure, absorbs the same quantity of heat; the same was found for formic ether; sulphide of carbon was found to possess too small an absorbing power to be well adapted for the experiment. By increasing the pressure of vapours or gases their absorbing power is of course increased, but at a smaller rate than the pressure. Thus, by submitting the vapour to a pressure of 10, the absorption power will increase to the amount a. By submitting it to a pressure of 20, an increase b will take place. But b will be smaller than $2a$.

M. Wurtz, in a paper on *methyl-allyl*, modifies and generalises the method by which he produced ethyl-allyl isomeric with amyl some time ago.

In vain he tried to obtain a substance isomeric with ethyl-allyl by the action of brominated propylene, C_3H_5Br, on zinc-ethyl. No perceptible action takes place. It has also been found impossible to displace the two bromine atoms of bromide of propylene, $C_3H_6Br_2$, by ethyl, although MM. Friedel and Ladenburg succeeded in effecting such displacement with methyl-chloracetal, $C_3H_6Cl_2 = \underbrace{CH_3CCl_2CH_3}$.

The action of zinc-amethyl on iodide of allyl requires a temperature of 120°. It engenders but a small quantity of methyl-allyl, $CH_3C_3H_5$. This compound is easily obtained by the method first used by M. Wurtz for the production of mixed radicles, and later by MM. Fittig and Tollers for the production of aromatic hydrocarbons.

Sodium is heated in a water-bath for several hours with iodide of methyl and iodide of allyl diluted with ether. Very strong, small, sealed glass retorts are used for the purpose. They are then exposed to a strong cold, opened, and emptied by distilling the liquid. The distilled portion is mixed with bromine. The bromine formed distills almost entirely between 155° and 165°. The portion distilling between 155° and 159° is pure bromide of butylene or pseudobutylene. The boiling point of real bromide of butylene is exactly the same. Decomposed anew by sodium, this bromide furnishes a hydrocarbon boiling at 6° below 0°, which combines with hydriodic acid to form C_4H_8HI, boiling between 116° and 118°. Its boiling point and density are the same which M. de Luynes found in iodhydrate of butylene. It would therefore appear that butylene is really methyl-allyl $CH_3.C_3H_5$. But as the boiling point of the former has hitherto been considered higher, M. Wurtz carefully reserves his final judgment.

M. Duclaux found the white crystalline compound

formed by the rapid evaporation of sulphide of carbon in moist air to consist of a *hydrate of sulphide of carbon*, $(CS_2)_2H_2O$.

This compound is decomposed at the temperature of 3° below 0. It was analysed by adding chloride of calcium to the decomposed product, and evaporating the sulphide of carbon, weighing the substance before and after the addition of chloride of calcium, and after evaporation.

M. Hulot, manufacturer of postage-stamps, communicates the fact that *aluminium-bronze* advantageously replaces steel in the instrument used for perforating the sheets of postage-stamps. It does not get blunt so soon as steel does in cutting paper.

M. H. St. Claire Deville adds some remarks to this note. He speaks of another innovation introduced by M. Hulot, namely, the addition of zinc amalgam to ordinary solder. The solder thus produced is applicable at low temperatures for cast iron and aluminium-bronze. He adds another remark on the curious properties of alloys. Ingots of an alloy of platinum and lead of 2 centimetres in thickness, were left four or five years side by side of similar ingots of pure lead. The latter were unaltered, whereas the lead of the former was entirely transformed into carbonate.

M. Mène publishes a great number of analyses of *anthracites*, showing very great differences in the proportion of volatile matter, carbon, and ashes, as well as in composition of the latter and their specific weights.

M. S. de Luca, physician at a hospital at Naples, remarks that sulphate of sodium, which, as everybody knows, prevents the fibrine of blood coagulating, is a good dissolvent for the spots sometimes formed on the cornea of the human eye. He applies the remedy in the shape of a fine powder.

ROYAL INSTITUTION.

DR. MILLER'S LECTURES ON SPECTRUM ANALYSIS.

In a previous number we noticed the first lecture of this course, which was concluded on Tuesday last. Each lecture was admirably illustrated by actual spectra and photographs thrown upon a screen by means of the electric lamp. The whole subject of celestial chemistry was plainly set before the audience. One of the most striking illustrations of this course was the beautiful spectrum of the new metal indium, which was probably seen for the first time by the greater number of the spectators. As most of our readers are aware, the indium spectrum is characterised by two blue lines. In the last lecture the impressive results obtained by Mr. Huggins and the lecturer were brought forward, and everybody present must have understood the methods by which the nature of the stars and nebulæ has been determined. The most remarkable observation made through the spectroscope, that connected with a variable star in Corona, was most lucidly described. Mr. Huggins obtained the spectrum of this star when in its brightest phase, and concluded that it must consist of a solid nucleus and gaseous atmosphere, together with an exterior envelope of ignited hydrogen.

CHEMICAL SOCIETY.

THURSDAY, JUNE 6.

Dr. A. W. Williamson in the chair. This meeting was held in the rooms of the Royal Society, and was attended by a very large number of Fellows and their friends. The attraction was a lecture by Sir Benjamin Brodie, Bart., *on Ideal Chemistry*, intended to elucidate his system of chemical notation, an abstract of which will appear in our next.—Professors Frankland, G. C. Foster, Maxwell, Odling, Wanklyn, and Williamson, Messrs. Davy, Newlands, and Stokes, joined in the discussion.

CORRESPONDENCE.

To the Editor of The Laboratory.

THE TITLE OF PROFESSOR.

Sir,—In your first number you gave us an article on Titular Letters. I was rather in hopes that it would have been followed by one on "What constitutes a Professor?" This still seems to be a *vexata quæstio* at the present day. We see persons advertising themselves as professors when we are positively certain that they do not hold chairs at any of the universities or public schools, and that they have not taken degrees in art or science. I think many like myself would like to know what really constitutes a professor. This question was answered in the following manner by 'Notes and Queries:'—"A very sensible question, and, considering how much it is abused, deserves a reply. I once heard Lord Ellenborough ask a witness what he was; he replied, 'A professor of music.' The query then was, 'Where did you take your degree?' 'Nowhere.' 'Then, sir, you are not a professor; you may teach music, but you are a mere music-master.' A professor receives a degree in art or science from an acknowledged university." Does this imply that if a man is B.A. or B.Sc. he is a professor of any subject he pleases to occupy himself with, whether for the love of it or through the stern necessity of getting a living? It is a great pity that the term chemist is so vague in England, as it does not convey to the people at large the real meaning; they at once think that the person is only a maker of pills and draughts. If Brown has passed scientific examination before special boards, such as the London University or School of Mines, and he then begins to practise on his own account, he has, doubtless, a right to call himself Mr. Brown, Professor of Chemistry; but if he has any respect for his own character, and wishes to gain the good opinion of others, he will refrain from styling himself Professor Brown. I think if the real meaning of the titles "Professor" and "Professor of Chemistry" were rightly understood by scientific men, no one having any regard for his own reputation would assume the former title unless he held a chair at a recognised college. Perhaps a few words from your pen would shame the pseudo-professors and raise the title to the proper dignity. I am, etc.,

Not a Professor.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

On Indium. By TH. RICHTER.†

INDIUM occurs most abundantly in the blendes of Freiberg, but is likewise found in those from some other localities. On distilling these blendes in the usual way for the extraction of the zinc, the indium passes over together with that metal. 100 kilogrammes of Freiberg blende yield from 25 to 40 grammes of indium.

To separate the indium, the zinc containing it is treated with sulphuric or chlorhydric acid, which dissolves the greater part of the zinc, leaving a residue containing indium, together with zinc, cadmium, iron, manganese, copper, tin, and lead. The evaporated solution is mixed with sulphuric acid, then diluted and treated with hydric sulphide, which completely precipitates the indium, cadmium, and copper. The precipitate is dissolved in chlorhydric acid; the solution precipitated by ammonia, this treatment being repeated till all the cadmium and zinc are separated from the indium; and finally the indium is freed from small quantities of iron by partial precipitation with ammonia or carbonate of sodium.

To obtain metallic indium, the oxide is reduced by hydrogen or coal-gas, in a porcelain crucible, and the reduced metal is fused under a layer of potassic cyanide.

Indium is a whitish metal, approaching platinum in colour. It is very soft and ductile; sp. gr. $= 7{\cdot}15$ at 20°. Atomic weight, referred to hydrogen, $= 71{\cdot}8$, regarding the metal as diatomic.

The hydrate is completely precipitated from its solutions by ammonia and potash, but the precipitation is prevented by the presence of tartaric acid. The oxide is dark brown while hot, straw-yellow when cold.

Hydric sulphide precipitates but a very small quantity of indium from its solutions in concentrated acids; but from very dilute solutions containing but little free acid, it throws down the greater part of the indium, and from solution in acetic acid the precipitation is complete.

Sulphide of indium has a fine yellow colour, like sulphide of cadmium.

The salts of indium are colourless. The chloride, obtained by passing a current of chlorine over the heated oxide, is extremely volatile, and crystallises in colourless, very hygroscopic laminæ.

On Thiosinnamine. By R. L. MALY.†

When bromine is added drop by drop to an alcoholic solution of thiosinnamine until all discoloration has ceased, thiosinnamine dibromide is formed, without any evolution of hydric bromide. The new bromide may be obtained by evaporation to dryness on the water-bath and recrystallisation from spirit or water. It forms brilliant six-sided prisms, which are usually colorless and brittle. Their aqueous solution produces an abundant precipitate with argentic nitrate; the fusion-point is 146°—147°. The author selects the rational formula—

$$\left.\begin{matrix} H_2 \\ CS \end{matrix}\right\} N$$
$$\left.\begin{matrix} C_3H_5H \\ Br \end{matrix}\right\} N, Br$$

for this substance; thereby indicating that one half of the bromine is analogous to the bromine in ammonic bromide, while the other has a different chemical function, and serves to complete the ammonium molecule; in fact, upon treatment with water and a known quantity of argentic chloride, exactly half of the bromine proves to be exchangeable for chlorine. Both the dibromide and chlorobromide form very definite platinum salts, which are anhydrous, and correspond respectively to the expressions

$$2[C_4H_8N_2SBr_2].PtCl_4 \text{ and } 2[C_4H_8N_2SBrCl].PtCl_4.$$

There are corresponding auro-bromides. A strongly alkaline hydrate (probably having the composition

$$C_4H_8N_2SBr.HO)$$

is obtained when the dibromide is treated with water and argentic oxide. Dr. Maly, considering thiosinnamine dibromide as a true analogue of sal-ammoniac, remarks that what was previously a theoretical difficulty may now be easily solved. In the decomposition of sal-ammoniac by sulphuric acid, it is impossible to determine whether the hydrogen of the hydric chloride evolved proceeds from sal-ammoniac or sulphuric acid. Of the rival equations—

$$2(HCl.NH_3) + H_2SO_4 = 2HCl + (NH_4)_2.SO_4,$$

$$2(NH_4Cl) + H_2SO_4 = 2HCl + (NH_4)_2\,SO_4,$$

the former represents a process of *fission*, the latter *reciprocal exchange*. Now, the dibromide referred to, instead of containing hydric bromide, is a compound of bromic bromide (Br.Br); and, on treatment with cold concentrated sulphuric acid, it evolves pure hydric bromide. Similarly, also, the bromochloride evolves hydric chloride. We see, therefore, from these reactions, that the hydrogen of the hydric chloride which is set free on heating sulphuric acid with sal-ammoniac is derived from the sulphuric acid by a process of reciprocal exchange, and that the group (NH_4) still remains unsevered.

On the Absorption of Carbonic Dioxide by certain Metallic Oxides. By J. KOLB.*

The author has confirmed the observation made long ago by Scheele, that anhydrous lime does not absorb carbonic dioxide, even after exposure for a considerable time, provided no water has access to it. He has likewise obtained similar negative results with the anhydrous oxides of barium, magnesium, potassium, and sodium, neither of these oxides, when exposed for a month in the state of fine

* 'Comptes rendus,' lxiv, 827 (22 April, 1867).
† In abstr. 'Zeit. Chem.' (1867), 42.

* 'Comptes rendus,' lxiv, 861 (29 April, 1867).

dry powder to a stream of dry carbonic dioxide, exhibiting the slightest increase of weight. The hydrates of calcium, barium, and magnesium also, when reduced to fine powder and dried at 120°, so as to deprive them of all uncombined water, are equally incapable of absorbing dry carbonic dioxide; so, likewise, are the hydrates of potassium and sodium, when melted and spread out in thin layers. The same substances, however, absorb the gas readily when it is saturated with moisture.

Under similar circumstances the conversion of a base into carbonate takes place the more quickly in proportion as it is more soluble in water; thus, lime is carbonated less quickly than baryta, but more quickly than magnesia. In the state of clear aqueous solution these three bases are converted into carbonates with equal rapidity [? magnesia], and when they are made into a paste with water, the quantity of carbonic dioxide absorbed by each in a given time is nearly proportional to the quantity of water present.

From these experiments the author thinks it probable that the fixation of carbonic dioxide by alkaline or alkaline-earthy bases is due to the action of the gas on the base in the state of solution. A better mode of stating the result is, perhaps, that carbonic dioxide or anhydride does not act upon bases till it is converted, by assumption of water, into carbonic acid or hydric carbonate, H_2CO_3, which then acts by double decomposition like other acids, *e.g.* $Ba''O + H_2CO_3 = Ba''CO_3 + H_2O$.

In the carbonatation of baryta, lime, and magnesia, the base passes to the state of insoluble carbonate, and the action is kept up by means of the water set free. In the case of potash or soda dissolved in a small quantity of water, the water thus liberated is retained by the carbonate as water of crystallisation, and the carbonatation is arrested after a while for want of water to continue it.

It is commonly stated that when lime is exposed to moist air, the ultimate product is a hydrocarbonate, containing $Ca''CO_3.Ca''H_2O_2$. Kolb, however, finds from numerous experiments that, after exposure for a sufficient time, the product formed is always the neutral carbonate, $Ca''CO_3$.

On certain Ketones. By G. Wischin.*

When a solution of phtalyl chloride in benzol is gradually mixed with zinc-ethyl decomposition ensues, and phenylene-diethylic ketone—

$$\left.\begin{matrix}(C_{12}H_4)'' \\ (C_4\ H_5)_2\end{matrix}\right\}\begin{bmatrix}C_2O_2 \\ C_2O_2\end{bmatrix}\dagger$$

is formed. It separates from its ethereal solution in beautiful large crystals, which fuse at 52°.

Ethylene-diethylic ketone—

$$\left.\begin{matrix}(C_4H_4)'' \\ (C_4H_5)\end{matrix}\right\}\begin{bmatrix}C_2O_2 \\ C_2O_2\end{bmatrix}\dagger$$

was prepared in like manner from succinyl chloride. It is a liquid heavier than water, of pleasant smell, and not to be distilled without decomposition. Both the above ketones are indifferent bodies.

* 'Zeit. Chem.' (1867), 46.
† C = 6,O = 8.

Contribution to the History of the Phenols. By L. Dusart.*

Berzelius, by treating naphthalene with sulphuric acid, obtained two sulpho-acids, viz. sulpho-naphthalic, or naphthyl-sulphurous acid, $C_{10}H_8SO_3 = (C_{10}H_7)\ HSO_3$, and disulpho-naphthalic acid, $C_{10}H_8S_2O_6 = (C_{10}H_6)''\ H_2S_2O_6$, the latter in small quantity only. Now, Dusart finds that by increasing the quantity of sulphuric acid and raising the temperature, the whole of the naphthalene may be converted into disulphonaphthalic acid. Ten parts of naphthalene and twenty-five parts of the strongest oil of vitriol are to be heated together till a sample of the liquid saturated with a concentrated solution of sodic carbonate remains perfectly clear, and no longer yields a crystalline precipitate of potassic sulphonaphthalate. The liquid is then to be diluted with water and saturated with an alkaline carbonate; the greater part of the sulphate removed by crystallisation; and the rest by evaporation. The remaining liquid yields on evaporation crystals of disulpho-naphthalate.

Disulpho-naphthalic acid is dibasic. Its salts are attacked by fusion with potash, like the sulphonaphthalates, yielding potassic sulphite and sulphate, and a potassium-compound of naphthylenic alcohol, $C_{10}H_8O_2 = \left.\begin{matrix}(C_{10}H_6)'' \\ H_2\end{matrix}\right\}O_2$.

$$\left.\begin{matrix}(C_{10}H_6)'' \\ K_2\end{matrix}\right\}S_2O_6 + 4KHO = 2K_2SO_3 + 2H_2O + \left.\begin{matrix}C_{10}H_6 \\ K_2\end{matrix}\right\}O_2.$$

The napthylenic alcohol may be separated from this compound by acids, and freed from a quantity of tarry matter which accompanies it by heating with water. The solution, when evaporated and left at rest, deposits naphthylenic alcohol in small rhombohedral crystals. This alcohol is more soluble in water than naphthol† (naphthylic alcohol, $C_{10}H_8O$), and dissolves easily in potash. The solution becomes almost black on exposure to the air, and after a while acids precipitate from it only a black acid, which in concentrated solutions almost solidifies to a jelly.

On Azobenzide. By P. Alexeyeff.‡

It had been stated by the author‖ that nitrobenzol, when submitted to the action of sodium-amalgam, yields azobenzide. Werigo§ has since tried this process, but without success. Alexeyeff has, however, repeatedly convinced himself of the accuracy of his previous assertion, and finds that azobenzide prepared by his method possesses the properties attributed to

* 'Comptes rendus,' lxiv, 859 (19 Avril, 1867). The author, like Berthelot, uses the term "phenol" as a generic name for the homologues of phenylic alcohol, and for naphthol and similar bodies of alcoholic nature derived from hydrocarbons.

† M. Dusart, in a sealed note communicated to the Academy on the 15th of April last, states that he has obtained naphthol by the action of potash on sulpho-naphthalate of potassium, but does not describe it. Its formation by this reaction had previously been noticed by Wurtz, who, however, did not obtain it pure. (See pp. 46, 63 of this volume).

‡ 'Zeit. Chem.,' 33.

‖ Ibid. (1864), 348.

§ 'Ann. Ch. Pharm.,' cxxxv, 176.

it by Zinin. If excess of sodium-amalgam be taken, azobenzide ($C_{12}H_{10}N_2$) is obtained, which is converted by prolonged action into hydrazobenzide, and not into benzidine (as stated by Werigo). The author takes the opportunity of correcting his former statement, due to working with small quantities of material, that azoxybenzide ($C_{12}H_{10}N_2O$) is reduced by sodium-amalgam to azobenzide; it is, in reality, completely transformed into hydrazobenzol. Some concluding remarks are made with respect to the great stability of azobenzide; it is, however, attacked both by phosphoric chloride and hypochlorous acid, with production of a blue dye. A further report on this reaction is promised.

On the Synthesis of Organic Acids. By L. CARIUS.*

If sulphuric acid be diluted with half its weight of water, then shaken with benzol and successive small quantities of potassic chlorate added at the uniform temperature of 18°, only chlorous acid is produced, some of the benzol being, probably, oxidised to benzenic acid:

$$C_6H_6 + 3ClHO_3 = C_6H_4O_2 + H_2O + 3ClHO_2.$$

But the principal product of the reaction is a substance which the author terms trichlorophenomalic acid (indicating thereby that it is the trichlorinated derivative of a homologue of malic acid):

$$C_6H_6 + (ClHO_2)_3 = \underset{\text{Trichlorophenomalic acid.}}{C_6H_7Cl_3O_5} + H_2O.$$

The new body is readily obtained pure by shaking with ether the acid liquid in which it has been formed, and, after evaporation, crystallising from hot water. Trichlorophenomalic acid is then deposited in monoclinic plates, which may be obtained from alcohol in prisms belonging to the same system. It fuses at 131°—132°, at which temperature it volatilises without change; on heating it a few degrees higher, decomposition takes place, with production of water and a new acid.

The chlorine in trichlorophenomalic acid can be easily substituted by hydrogen. This may be effected in an aqueous solution by adding zinc and, finally, a little hydric chloride. The product is an amorphous, very soluble acid, which yields amorphous and generally unsatisfactory metallic derivatives; it is, probably, normal phenomalic acid. Excess of zinc and concentrated aqueous hydric chloride, or hydric iodide, transforms the chlorinated acid ultimately into succinic acid:

$$C_6H_{10}O_5 = C_4H_6O_4 + C_2H_4O.$$

Carius has not traced the history of the residue (C_2H_4O), which he believes to be altered in the course of the reaction; but he has made a most minute and extended comparison of succinic acid from this source with ordinary succinic acid, and is unable to discover any difference between them.

If trichlorophenomalic acid be boiled with water, more especially in presence of baric hydrate, the following reaction takes place:

$$C_6H_7Cl_3O_5 + H_2O = C_6H_6O_6 + 3HCl.$$

The body ($C_6H_6O_6$) is isomeric, but not identical with aconitic acid. The author names it "phenaconic acid," and attributes to it the rational formula—

$$O_3 \begin{cases} C_6H_2(OH)O_2 \\ H_3. \end{cases}$$

Phenaconic acid crystallises, with one proportion of water, in monoclinic prisms and lamellæ; by sublimation it is obtained in the form of brilliant columns. 1 part of the acid dissolves in 148·7 parts of water at 16°5; it sublimes at 170°, but decomposes at a higher temperature into water and a new acid. It does not form a nitro-compound, but only oxalic acid, when treated with nitric acid. Half its hydrogen can be exchanged for metals; and the derivatives so produced are crystalline and, for the most part, soluble in water. Triethylic phenaconate is an oily liquid, volatile without decomposition.

The author mentions the following substances as also occurring in the reaction between benzol and chlorous acid, viz. oxalic acid, an uncrystallisable chloro-acid (of the same composition as the trichlorophenomalic), chloro-benzol, and, perhaps, monochlorophenol.

On some Derivatives of Cinnamic Acid. By C. GLASER.*

The author gives a brief summary of the results he has obtained in the above direction up to the present time. Phenyl-monobromolactic acid ($C_9H_9BrO_3$) is prepared either by direct addition of bromine to cinnamic acid and treatment of the product with boiling water, or by the combination of hypobromous acid with cinnamic acid. It crystallises from water in quadratic prisms or small six-sided scales, containing half a molecule of water of crystallisation, which escapes on exposure to dry air. The acid is easily soluble in water, alcohol, or ether; it separates from the last-named solvent in minute four-sided prisms, whose fusion-point is 125°. It cannot be sublimed unchanged, and its proneness to decomposition has hitherto prevented the author from obtaining definite salts. Hydric bromide converts it into phenyl-dibromopropionic acid (dibromocinnamic acid); hydric chloride transforms it into phenyl-chlorobromopropionic acid ($C_9H_8ClBrO_2$), a body which crystallises in rhombric plates, which fuse, with decomposition, at 175°. This last substance may also be formed by submitting phenyl-monochlorolactic acid to the action of hydric bromide; and phenyl-monochlorolactic acid, in its turn, is obtained by addition of hypochlorous acid to cinnamic acid. It crystallises in minute scales.

Phenyl-lactic acid is the product of the action of sodium-amalgam on its monobrominated derivative. It is white and crystalline, and melts at 82°. The silver salt is a white precipitate, which can be crystallised from water. The acid itself, on treatment with

‡ 'Zeit. Chem.' (1867), 72.

* 'Zeit. Chem.' (1867), 65.

hydric chloride or bromide, furnishes the chloride ($C_9H_9ClO_2$) or bromide ($C_9H_9BrO_2$), which are deposited from water or alcohol in stellate groups of rhombic crystals; the bromide decomposes with alcoholic potash, forming hydric bromide and cinnamic acid. Phenyl-oxyacrylic acid ($C_9H_8O_3$) is produced by treating phenyl-monobromolactic acid with alcoholic potash, which removes the elements of hydric bromide; it may be separated from its potassic salt by an acid which precipitates it as an oil, speedily becoming crystalline. Hydric bromide seems to convert it into one of the two isomeric monobromocinnamic acids. Phenyl-dioxypropionic acid ($C_2H_{10}O_4$) is prepared by adding argentic nitrate to a solution of phenyl-monobromolactic acid in dilute ammonia; it is an oily substance, volatile with the vapour of water. The silver salt is but slightly soluble in water, and crystallises in small needles.

On the Chemical Decomposition induced by Mechanical Action on Felspar and other Minerals. By A. Daubrée.*

The author has shown by numerous experiments that felspathic rocks, when rubbed together under water, as in the beds of rivers, undergo, not only mechanical division, but likewise a certain amount of chemical decomposition, rendered evident by the communication of an alkaline reaction to the water.

The experiments were made by triturating the stones together in rotating cylindrical vessels of stone-ware or iron, the velocity of the movement being about the average of that of running waters, that is, about 2550 mètres per hour, and the weight of water about double that of the stones.

Orthoclave from Limoges, triturated in this manner with pure water, in stone-ware vessels, yielded silicate of potassium to the water, which rendered it alkaline. It was shown by a special experiment that the alkaline silicate was not derived from the substance of the vessel. When the same experiment was made in an iron vessel, the water likewise became alkaline, but contained only potash, without a trace of silica, the dissolved alkaline silicate having been decomposed by oxide of iron, resulting from the oxidation of the fine particles of iron separated by attrition from the inner surface of the vessel. Three kilogrammes of felspar, rotated for 92 hours in an iron cylinder containing 5 litres of water (the movement being equivalent to a course of 460 kilomètres), yielded to the water 12·60 grammes of potash, or 2·52 grms. to a litre.

The water also takes up a small quantity of alumina, together with traces of chlorides and sulphates. The presence of these salts in the solution is due to their mechanical interposition between the particles of the rock; but that of the silica, potash, and alumina, cannot be accounted for in the same way; in fact, dry felspar, even if reduced to an impalpable powder, will not communicate to water more than the slightest trace of alkaline reaction, the decomposition taking place only under the simultaneous influence of mechanical division and the solvent power of water.

The decomposition is greatly retarded by the presence of common salt in the water, and accelerated by the presence of lime or of carbonic acid.

Felspar, previously heated to whiteness, is decomposed in the manner above mentioned, much more quickly than the same mineral in its natural state.

Obsidian and leucite, treated in the same manner, yield but traces of alkali to the water.

* 'Comptes rendus,' lxiv, 339 (25 Février, 1867).

VARIA.

The new number of the 'Fortnightly Review' is remarkable for an article by Professor Tyndall on *Miracles and Special Providences.* This paper is an answer to Mr. Mozley, who treated the question in the Bamptom Lectures for 1865.

The Royal Commissioners appointed to inquire into the coa resources of the United Kingdom have appointed Mr. Evan Daniel, of Swansea, their engineer for the district extending from Llantrissant, Glamorganshire, to the extreme end of the South Wales mineral basin, in Pembrokeshire.

The Medical Council has directed the necessary advertisements to be inserted in the London, Dublin, and Edinburgh 'Gazettes' of Friday, June 14th, from which date, all the formalities prescribed by Parliament having been complied with, the new Pharmacopœia of 1867 legally supersedes all other Pharmacopœias whatsoever, and its use becomes compulsory.

At a recent meeting of the Irish Medical Association in Dublin a resolution was passed, declaring that the Medical Reform Act, as carried out by the Medical Council, has failed in securing for the medical profession the advantages originally intended, and that an adequate return has not been given for the expenses incurred. It was suggested that a "uniform curriculum of high preliminary education, and of professional and scientific study, be adopted for all licensing bodies empowered under the Act to grant licenses or diplomas in medicine or surgery, as the best means of maintaining the status and respectability of the profession."

The Foreign Office at Pekin have issued a memorial on Western education. The 'Overland China Mail' considers it the most interesting document which the Chinese Government has ever promulgated. It sets forth that the time has come for change in the education of its officials, and adduces a series of arguments in support of its views. The memorial informs its readers "that the germ of Western sciences is, in fact, originally borrowed from the heaven-sent elements of Chinese knowledge. The eyes of Western philosophers having been turned towards the East, and the genius of these men being minutely painstaking and apt for diligent thought, they have succeeded in pursuing study to new results. For these they have usurped the name of sciences brought from over sêa; but in reality the methods (of their philosophy) are Chinese methods. This is the case with astronomy and mathematics, and it is equally so with the remaining sciences. China has originated the method, which Europeans have received as an inheritance."

Books Received.—The Elements of Natural Philosophy, or an Introduction to the Study of the Physical Sciences. By Charles Brooke, M.A., F.R.S., etc. Churchill and Sons. On Defects in the Apparatus generally used for the Determination of Bisulphide of Carbon in Coal-gas. By A. G. Anderson. Clayton and Co.

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

MEETINGS FOR THE FORTHCOMING WEEK.

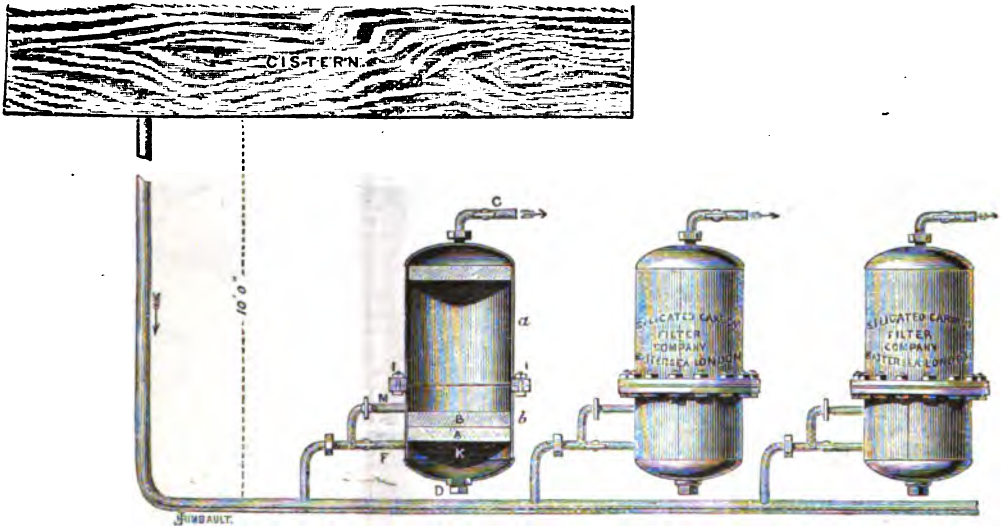
June.

Tuesday, 11. Photographic Society. 8 p.m.
Wednesday, 12. Microscopical Society. 8 p.m.
Friday, 14. Astronomical Society. 8 p.m.

SILICATED CARBON MAIN SERVICE FILTER.

This Filter shown in section, consists of a metal case in two parts, A and B, fastened by nuts and screws I, I. The water enters by the pipe F, passing first through the coarser filtering medium A, then through the finer B, and flowing off pure through the pipe C. The coarser impurities are thus arrested by A, and do not interfere with the action of B; they also accumulate in the cavity K, and may be removed when requisite, by allowing the water to pass into the filter through M. This is done in a few seconds by opening the tap M and closing F, at the same time shutting the exit pipe C, and unscrewing the nut D. The water entering the upper cavity at E, will thus be forced downwards carrying off all impurities which have been arrested by the filtering medium A. These filters are used by the General Post Office, the London Hospital, the County Prison, Swansea, and many Noblemen's, Gentlemen's, and other large Establishments.

Prices, in Tinned Copper Cases, £6 6s., £8 8s., £12 12s., £18 18s.



TESTIMONIAL.

"General Post Office, Medical Department; 23rd October, 1860.

"This is to certify that, having inspected and examined the filtering apparatus erected by the *Silicated Carbon Filter Company* at the Money Order Office, where it supplies filtered water for about 130 officers, I am perfectly satisfied with its action. The water is filtered with considerable rapidity, at the same time that this is efficiently done. I recommend this system to Government and other large offices, in preference to any other with which I am acquainted.—Waller Lewis, M.D., Medical Officer G.P.O."

Effect of the SILICATED CARBON FILTER *upon* Thames Water *obtained near Battersea Bridge at High Water.*

	Unfiltered.	Filtered.
Total solid contents of an Imperial Gallon	33½ gr.	8·7 gr.
Hardness, as determined by Clarke's Test	9 deg.	6 deg.

	Unfiltered.	Filtered.
Earthy Carbonates deposited by boiling 1 Gallon	11· gr.	None.
Organic matter contained in an Imperial Gallon	3·8 gr.	0·6 gr.

The Unfiltered Water was of a greenish-yellow colour, and during evaporation gave out a most offensive odour, the residue being a dark brown mass of organic and saline impurities. When passed *once* through a *Silicated Carbon Filter* it became perfectly colourless, sweet, and drinkable. During evaporation not the slightest odour was perceptible, and the residue was quite white, and consisted of little more than chloride of sodium (common salt).

Illustrated and Priced Lists of all classes of Filters on application to the

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1867, Dec. 19.

THE LABORATORY:

A Weekly Record of Scientific Research.

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CONTENTS.

THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science. Though only ten numbers of THE LABORATORY have as yet appeared, many well-known names may be mentioned in conjunction with its articles, as will be seen by the following list of the principal contributors:

A. Matthiessen, Ph.D., F.R.S., Lecturer on Chemistry at St. Mary's Hospital.
W. H. Perkin, F.R.S.
Maxwell Simpson, M.D., F.R.S.
Henry Watts, B.A., F.R.S., Editor of the new 'Dict. of Chemistry,' &c.
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Michael Foster, M.D., Professor of Chemical Physiology, Univ. Coll., London.
J. A. Wanklyn, Professor of Chemistry at the London Institution.
William Dittmar, Principal Assistant in the Laboratory of the University of Edinburgh.
Herbert McLeod, Chemical Delegate to the Paris Exhibition.

C. W. Quin, F.C.S., Superintendent of the Chemical Classes of the Exhibition of 1862.
C. R. C. Tichborne, Chemist to Apothecaries' Hall of Ireland.
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H. N. Draper, F.C.S.
J. Ferguson, M.A.
C. Hockin, M.A., Fellow of St. John's College, Cambridge.
C. Lauth, Paris.
A. Oppenheim, Ph.D., Paris.

To the above list may be added the names of some of the eminent writers whose articles will shortly appear:

A. Kekulé, Ph.D., University of Ghent.
Father Secchi, Director of the Observatory at Rome.
A. Naquet, Paris.
Robert Galloway, F.C.S., Professor of Practical Chemistry, Museum of Irish Industry.
Thomas Richardson, Ph.D., Lecturer in Chemistry, University of Durham.
A. F. Marreco, F.C.S.
Rev. J. H. Jellett, M.A.
H. B. Brady, F.L.S., F.C.S.
Emerson Reynolds, M.D.

Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzosalicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iod-acetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *Geber*, an Historical Study.

Among the principal Editorial Articles are the following:—*Titular Letters; Proposed Amendment of the Pharmacy Act; The British Museum Reading Room; International Banquet at Paris; Glyptic Formulæ; The Wages of Science; Position of the Analytical Chemist; A Chemical Diploma; Hall of Arts and Sciences; Industrial Education.*

Critical Reviews of the following important books have appeared:—*Kühne's Physiological Chemistry; British Pharmacopœia; Bloxam's Chemistry; Brande's Dictionary of Arts and Sciences.* Numerous minor works have been noticed.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

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Post-Office Orders to be made payable to the Publisher, James Firth, at the Cannon Street Office.

Back Numbers can yet be obtained.

ORIGINAL COMMUNICATIONS.

DR. MATHIESSEN AND MR. HOCKIN ON SPECIFIC GRAVITY.

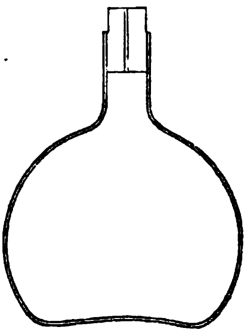
On the Specific Gravity of Liquids and of Bodies lighter than Water. By A. MATTHIESSEN, *F.R.S., and* C. HOCKIN, *M.A.*

IT is our intention in a series of papers to publish the methods generally used for determining some of the physical properties of liquids and gases. This series will serve as a sort of appendix to our papers on the physical properties of alloys, where we only treat of the methods for the determination of the properties of solids.

I. *On the Specific Gravity of Liquids.*

The method most commonly used is the following :—A flask of shape of fig. 1 is employed; it is made of thin glass, and has a well-fitting

Fig 1.

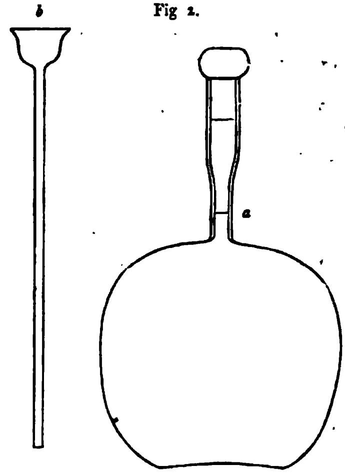


stopper with a small cylindrical hole through it. This flask, as usually sold, contains from 50 to 100 cubic centimetres.

Preferably a flask of the form of fig. 2 may be used. It is furnished with a stopper, and is filled with the fluid up to the mark *a* in the neck. It has the advantages that it may be filled without wetting the outside, which wetting must occur when the flask fig. 1 is filled, and the stopper put in; and that when filled no loss can occur by evaporation or expansion due to change of temperature. For filling and drying the flask fig. 2, it is convenient to use a hair tube with a funnel blown at one end, as shown in fig. 2, *b*. In taking an accurate specific gravity the liquids should have, as nearly as possible, the temperature of the balance, in order to prevent, as far as possible, different amounts of moisture being deposited on the glass.

For the determination of the specific gravity of any liquid three weighings are, of course, necessary—namely, that of the empty flask, that of the flask filled with water, and that of the flask filled with the liquid the specific gravity of which is to be determined. The flask is, therefore, first thoroughly cleaned, dried, and weighed, the weight being only taken when the flask ceases to increase in weight by deposition of moisture. Of course, where accuracy is required, it need hardly be stated that flask fig. 2 should be used—in fact, for volatile liquids, such as ether, it is indispensable.

Fig 2.



For the second weighing, the flask is filled with well boiled out water, of about the temperature of the balance, and by means of bibulous paper water is taken out until its level reaches to the line *a*. It is then placed in the pan of the balance, and the weight taken as soon as it ceases to increase by deposition of moisture.

For the third weighing the flask should be first emptied, dried, and filled, in the same manner as it was with water, with the liquid to be experimented with, and its weight taken as before; of course, the temperature of the water when filling in, as well as that of the liquid, must be carefully taken; the temperature of the balance must also be noted at each weighing; if the weighings are made one after the other on the same day, the height of the barometer need be only once read off, except where the greatest accuracy is required. To calculate the specific gravity with the results thus obtained—

Let t be temperature at which the flask was filled with water,

Let t' be temperature at which the flask was filled with fluid.

τ, π temperature and pressure of air during first weighing.

τ', π' temperature and pressure of air during second weighing.

τ'', π'' temperature and pressure of air during third weighing.

W_1 weight of empty flask in air.

W_2 „ flask full of water in air.

W_3 „ „ „ liquid to be determined.

S_t' sp. gr. of liquid at temperature t'.

ρ_t „ water „ t.

$\sigma_{\tau, \pi}$ „ air „ τ and pressure π

s sp. gr. of weights.

s' „ glass.

k_t ratio of volume of glass at temperature t to volume at 0°.

V volume of flask at 0°.

Then, volume of the glass $= \dfrac{W_1}{s'}$ nearly,

and „ „ water $= \dfrac{W_2 - W_1}{\rho_t}$ nearly.

$$\text{Let } \frac{W_1}{s'} + \frac{W_2 - W_1}{\rho_t} = v,$$

let w be weight of flask in vacuo,

$$\text{then } w = W_1 \left(1 + \sigma_{\tau, \pi} \left(\frac{1}{s'} - \frac{1}{s} \right) \right) \text{ .... I,}$$

and from second weighing—

$$w + V . k_t . \rho_t - \sigma_{\tau', \pi'} v = W_2 \left(1 - \frac{\sigma_{\tau', \pi'}}{s} \right) \text{...II,}$$

and from third weighing—

$$w + V . k_t' S_t' - \sigma_{\tau'', \pi''} v = W_3 \left(1 - \frac{\sigma_{\tau'', \pi''}}{s} \right) \text{...III;}$$

whence from III—

$$V . k_t' . S_t' = W_3 - w + \sigma_{\tau'', \pi''} \left(v - W_3 . \frac{1}{s} \right) = W'_3 \text{ say,}$$

and from II—

$$V . k_t \rho_t = W_2 - w + \sigma_{\tau', \pi'} \left(v - W_2 . \frac{1}{s} \right) = W'_2 \text{ say,}$$

$$\text{and } \frac{k_t' . S_t'}{k_t . \rho_t} = \frac{W'_3}{W'_2},$$

$$\text{and } S_t' = \frac{k_t}{k_t'} . \rho_t . \frac{W'_3}{W'_2} \text{ .... A.}$$

The formula is simplified if $\tau'' = \tau'$ and $\pi'' = \pi'$, as will generally be the case; then we have—

$$S_t' = \frac{k_t}{k_t'} . \rho_t . \frac{W_3 - w}{W_2 - w} \left(1 + \left(v - \frac{w}{s} \right) \text{ ....} \right.$$

$$\left. \frac{W_2 - W_3}{(W_2 - w)(W_3 - w)} . \sigma_{\tau', \pi'} \right) \text{ .... B.}$$

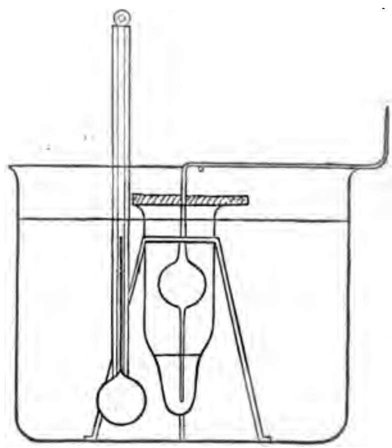
This formula will be sufficiently accurate except where absolute accuracy is required. It may be further simplified, for $\sigma_{\tau', \pi'}$ will nearly $= \sigma_{\tau, \pi}$,

$$\text{and } S_t' = \frac{k_t}{k_t'} . \rho_t . \frac{W_3 - W_1}{W_2 - W_1} . \text{ ....}$$

$$\left(1 + \sigma_{\tau, \pi} . \frac{W_2 - W_3}{W_3 - W_1} \right) \text{ .... C.}$$

This formula will not introduce an error of 0·01 per cent., except in extreme cases, where the temperature of pressure of the air has altered

Fig. 3.



very much. The same formula may be used if a flask of the form of figure 1 is employed.

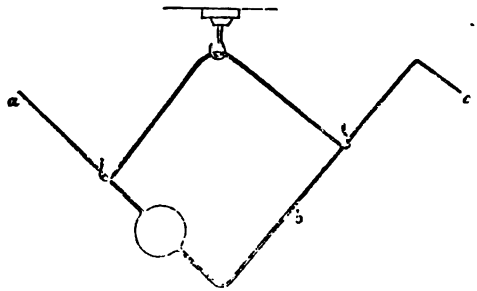
$\dfrac{k_t}{k_t'}$ is nearly one. When the temperatures do not vary above one or two degrees this correction need not be made; for five degrees the correction would be about 0·01 per cent., taking the value of $k = 0·000026$ for each degree. It must be remembered that the flask fig. 2, containing 50 grammes water, may be weighed to an accuracy of at least 0·0005 gramme, which would correspond to an error of 0·001 per cent.*

* In calculating out the specific gravity of a liquid by formula C, the tables given in this journal (pp. 17, 18) will be found useful. Attention, however, must be drawn to a clerical error in Table IV. In the third column, giving the values of $\frac{p}{760}$ from 760 upwards, the characteristic is given as 1. It should be 0.

In many cases, however, only a very small quantity of the liquid is to be had; in such instances the following method may be adopted by which considerable accuracy may be obtained, even with so small a quantity as 0·5 gramme of the liquid. To test its accuracy, the subjoined experiment was made.

A small bulb was blown with a very fine hair tube at each end, as shown in figs. 3 and 4, the diameter of the tube *a* being less than that of *b*, *c*, and about 0·05 mm. diameter. A much finer tube might have been used. The liquid chosen for the experiment was anhydrous ether. The ether was poured into a test-tube, which was placed in a beaker filled with water; the test-tube being closed at the top with a loose plug of wool. The bulb being introduced as shown in the figure (3), and the ether sucked up at the end *c* by means of an air-pump, or otherwise, it was left for some time to take the temperature of the surrounding water. Owing to the smallness of the diameter of the tube, the liquid does not flow out of it, or it does so only to such a small extent that even when the tube is placed in the position as shown in fig. 3 it may be left for a considerable length of time without losing much. After a quarter of an hour the tube was re-filled a little above the mark *b*; it was then taken out of the test-tube and a quantity of ether drawn out of the tube by drawing the end *a* across the finger, until the level of the liquid reached the mark *b*. The bulb was then tilted up so that the ether sank some little distance into the tube *a*, and in such a position it was hung, as shown in fig. 4, by a

Fig. 4.



light piece of glass thread to the balance. The weights were as follows:

Weight of flask and holder, 1·1060 grm.;
" " ether, 1·6098 " at 12°·5;
" " ether, after being in the balance one hour, 1·6094 "

showing a loss of 0·0004 grm. in the weight by evaporation through the fine tubes during the space of one hour. The tube was now emptied and re-filled with another sample of anhydrous ether; it was then found to weigh 1·6082 grm. at 10°·2; emptied and refilled, it weighed 1·680 grm. at 10°·4; emptied, dried, and filled with water, it weighed 1·7970 grm. at 15°·8; flask empty, with holder, weighed as before, 1·1060 grm. Temperature of air 15°·8, and pressure 755 millimetres.

From these values the specific gravity of ether will be found according to the formula C at 10°·2 = 0·7271.

To check this value, a large stoppered specific-gravity bottle, of the form of fig. 2, was filled and weighed with the same ether, when the following values were obtained:

Weight of empty flask, 14·3085 grms.

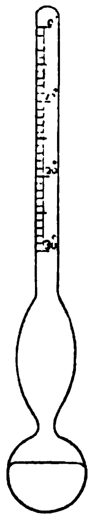
Weight of flask full of ether, 58·5655 grms.; temperature of ether, 15°·8.

Weight of flask full of water, 75·7727 grms.; temperature of water, 15°·8.

Temperature of the air, 15°·8, and pressure, 756 mm., during the experiments.

Hence, according to formula C, specific gravity of ether at 05°·8 = 0·7204. Reduced to temperature 0°, using Kopp's value for the expansion of ether, the specific gravity from experiment 1 will be 0·7375 at 0°, and from experiment 2 will be 0·7373 at 0°.

Fig. 5.



When no great accuracy is required, the hydrometer is a useful instrument for determining the specific gravity of different liquids. Very many sorts of hydrometers are in use, the principle involved being much the same. The simplest form of hydrometer is shown in the sketch, fig. 5, being a glass bulb, constructed with a glass stem, upon which a scale is engraved. If this instrument, floating in water, is immersed up to the point 0°, it will in a heavier fluid not sink so far, and in a lighter will, of course, sink deeper.

By making the stem small in bulk compared to the globe at the bottom greater delicacy is acquired, and for this reason arbitrary scales are employed according to the nature of the liquid to be determined, the stem being finer or thicker, according to the range through which the instrument is to work. These instruments are so well known that it is unnecessary to describe them here.

II. *On the Specific Gravity of Solids lighter than Water.*

One of the best methods is to weigh the substance first in air and then in water with a

piece of some heavy metal, say platinum, attached to it by means of a fine wire, so that it sinks in the water.

Let w be the weight of the platinum and wire alone, in water,

w', the weight of the platinum, wire, and body attached, in water.

Then, if W = weight of body in air, V_t volume at temperature t°, the rest of the notation being the same as before—

$$(w - w')\left(1 - \frac{\sigma_{\tau,\tau}}{s}\right) = V_t\,(\rho_t - S_t)$$

$$W\left(1 - \frac{\sigma_{\tau,\tau}}{s}\right) = V_\tau\,(S_\tau - \sigma_{\tau,\tau}),$$

$$\text{and } S_t = \rho_t \cdot \frac{W}{W + w - w'} + \sigma_{\tau,\tau} \cdot \frac{S_t}{S_\tau}\,\frac{w - w'}{W + w - w'} \;\ldots\ldots\ldots\ldots\ldots\ldots\; D;$$

and since $\frac{S_t}{S_\tau}$ is nearly = 1,

$$S_t = \rho_t \cdot \frac{W}{W + w - w'} + \sigma_{\tau,\tau} \frac{w - w'}{W + w - w'} \;\ldots\ldots\; E.$$

A few words need only be said with respect to the determination of the specific gravity of powders or small fragments of substances, minerals, etc. A good method to determine the specific gravity is to weigh them in a bucket in water, the bucket being made of a light piece of glass tubing (test-tube), to which a piece of fine platinum wire is fastened. The tube must be first weighed in air and then in water. The powder or mineral is then weighed in the dry bucket, which is then half filled with water, and, to drive out the air attached to the particles of the substance, it is placed in a vessel containing hot water; after remaining there a short time it is removed and placed under the receiver of an air-pump, which removes, on creating a vacuum, most of the air; this operation ought to be repeated once or twice, in order to remove completely all the air. After this has been done the bucket, with the substance, is weighed in water, and to calculate accurately the specific gravity of the weighings formula E may be used, where w represents the weight of the glass alone in water, and w' the weight of the glass and the substance in water.

ARTICLES IN PREPARATION.—We are in a position to promise our readers original articles by the eminent foreign chemists and physicists, Professor Kekulé, Father Secchi, MM. Naquet, Longuinine, Silva, and Salet, in early numbers. A series of articles on the Chemistry of Brewing will be commenced next month. An article on the Construction and Testing of Electric Cables is also in preparation.

MR. TICHBORNE ON CHLOROPHYLL.

On some Spectral and other Observations in connection with Chlorophyll. By CHARLES R. C. TICHBORNE, *F.C.S., Chemist to Apothecaries' Hall of Ireland.*

IN the following paper I employ the term chlorophyll the actual leaf green, or leaf greens, produced by the action of light in vegetation—not the corpuscles, or granules of the vegetable physiologists. Leaf green has probably never been obtained in a state of absolute purity, and this fact may in a measure account for the mystery which still hangs over this important substance.

I have from time to time examined the absorption-spectra from a great number of leaves, more for the purpose of investigating the changes that take place on the approach of autumn, and in particular those connected with deciduous trees, in which a decided change is manifested in the tone of the foliage. Alcoholic tinctures were used for the examination of the spectra.

I may premise that the phenomena of absorption-spectra, may be divided for convenience into two kinds—first, distinct bands, or markings, which, with the same substance, always have one definite position in the natural spectrum; and secondly, a general obscuring of the transmitted rays of certain parts of the spectrum. These absorptions are sometimes ushered in by an almost imperceptible gradation. The phenomena of the second order vary, not only in intensity, but in their extent and position in the spectrum, according to the strength of the solution through which the light passes. However, I do not mean to convey an impression that there is any very decided line of demarcation between the distinct bands and the more obscure shadings. Thus, often in the first class will be found bands which, although well marked and definite in position, will seem on one side to encroach or recede according to the volume of the fluid viewed, or, what is tantamount to the same thing, the strength of the solution. Again, what appears at first sight to be an individual band will frequently, on careful examination, be found to consist of two bands. Fig. 3 (a spectrum from one of the firs) is an illustration of this. The drawing of this spectrum was kindly sent to me by my friend Dr. Emerson Reynolds. There is little doubt that β band is a double one in all chlorophyll spectra, and I believe Prof. Stokes has surmised this fact. It must, however, be borne in mind that, in a certain sense, the phenomena are all comparative, for as there is no perfect absorption, so likewise there is no

perfect transparency in any medium. To this I may add that, however sharply the bands may appear, there is always a certain amount of shading.

In the observations made upon chlorophyll from different plants and at different seasons, the most remarkable point noted was the sameness of the spectra. Leaves the most dissimilar in tone to the eye gave the usual chlorophyll bands, with some trivial modifications. The chlorophyll spectrum has been described by Prof. Stokes, to whom we are almost entirely indebted for our knowledge in this and similar investigations.*

From the observations made by myself I have come to the conclusion that the ordinary chlorophyll spectrum, as produced by the green colouring matter, is always present in leaves when in an active state of vegetation, whatever colour the leaf may be, and however the spectrum may be modified by the presence of other substances. The darkest leaves, such as the purple nut (*Corylus purpurea*), which, when viewed in the ordinary manner, could not be called green, show nothing out of the common with the ordinary spectra from leaves. The red fluorescence, which is a natural property of chlorophyll, is very strongly developed in such leaves, and also seems to increase with the autumnal tint of ordinary plants.

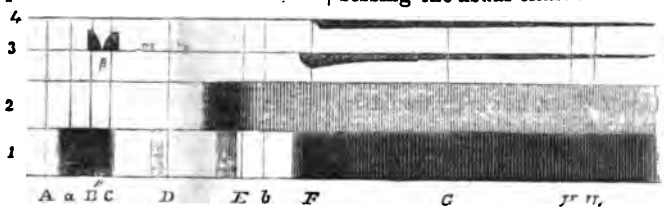
What pure chlorophyll is, is difficult to say; but one thing is quite evident, that the yellow colouring matter of leaves (which is easily separated by such solvents as cold benzol) cannot come under that name. The yellow, brown, and red colouring matters exist in leaves quite independently of the green.*

If a leaf is perfectly dried at 100° C., or over sulphuric acid, and treated with benzol, it will be found that the solvent dissolves with other substances a brilliant yellow extractive. On boiling, particularly if the vegetable matter is not quite dry, it will take up a little leaf green.

M. Fremy's phyllocyanin is incontestably a product of decomposition, although Dr. Miller, in the last edition of his 'Organic Chemistry,' seems to ignore the experiments of Dr. Stokes in connection with the fact.†

I have given some drawings of spectra connected with my subject. In the above drawings it will be seen that in two of them I have made use of the graphic method used by Bunsen to represent the spectra of the metals. I was induced to do so as it will be seen at once how much better it is suited to represent absorption-spectra than the bright lines in the spectra of the metals.

Fig. 1 represents the summer spectrum of Virginian creeper (*Ampelopsis hederacea*), possessing the usual characteristics of chlorophyll.



In Fig. 2, which represents the autumnal spectrum of the Virginian creeper when the foliage has changed to a bright scarlet, the chlorophyll is quite obliterated, and nothing remains but a spectrum such as would be produced by a solution of nitrate of cobalt. (*Liquidambar styraciflua* and some other plants give similar spectra.)

Fig. 4 represents the action of light upon chlorophyll in alcohol. In water the solution gradually fades when exposed to light, the band β being the last that is obliterated.

The important part that chlorophyll must play in connection with vegetable existence cannot be ignored. It must either be the direct medium for the transfer of oxygen to assimilable juices of the plant, or, what is more probable, a transient phase of these metamorphic substances. From its intimate relation to solar influence, the probable difference in gaseous exhalations observed in leaves during day and night may be attributed to chlorophyll. Although a nitrogenous substance, it is essentially connected with the elaboration of amylaceous products, viz. starch, sugar, and fatty matter. Prof. De Luca (University of Naples), who has devoted many years to the investigation of this subject, in a letter to me writes as follows in connection therewith:

"My published researches‡ in connection with

* Prof. Stokes says that there are two distinct greens and two yellows in the ordinary green known as chlorophyll (vide 'Journal of the Chemical Society,' vol. ii, p 304, and 'Proceedings of the Royal Society,' vol. xiii, p. 144).

* "I find the chlorophyll of land plants to be a mixture of four substances, two green and two yellow, all possessing distinct optical properties."—Prof. Stokes "On the Identity of Biliverdin and Chlorophyll," 'Proceedings of the Royal Society,' vol. xiii, p. 144.

† Miller's 'Organic Chemistry,' 3rd edition, p. 698.

‡ '*Ricerche sull 'Estrazione della Mannite Dalle Foglie di Ulivo,*' per S. de Luca, and others, published by the Royal Academy of Science, Naples, 1865.

your subject were instituted for the purpose of determining at what period of vegetation the fatty and other matters were found in the olive tree, and what are the materials which gave them birth. The chlorophyll which I found in abundance in the leaves and fruits of the olive tree always accompanied the mannite. "This matter" [the mannite] "exists in small quantities as the leaf begins to develop itself, augments with the growth of the olive, diminishes during the flowering of the plant, and when the leaves begin to lose their green tint it disappears entirely, the yellow leaves falling spontaneously from the plant. The leaves of the olive tree are perpetual, that is to say, they do not become detached from the plant until the new green leaves are formed and developed. The olives as long as they contain chlorophyll contain mannite, but when they are ripe the mannite and leaf green disappears. The decrease of the mannite and chlorophyll in the olive during the development of the fatty matter and the destruction of the same substance, when the fruit contains a maximum of oil, show that there must exist some relation between all these matters."

We see, therefore, from Prof. De Luca's remarks, that the most important substance secreted in this plant is changed simultaneously with the chlorophyll. Mannite itself undergoes some most curious decompositions, which may be connected with the formation of the fatty acids—namely, saponifiable compounds, which seem almost identical with the natural oils. To enter upon this matter, however, would be a digression from my present theme.

The extraordinary sensitiveness of chlorophyll to light when in the presence of moisture and atmospheric oxygen is most marked. The following experiments will illustrate this point. I took the leaf-green, which had been freed as much as possible from the yellow extractive, and dried it over sulphuric acid. The green powder produced in this manner was mixed with benzol which had previously been distilled from sodium; it was sealed in a tube and exposed to direct sunlight, but no marked change took place. To a similar tube, half filled, a drop of water was added, and the tube was exposed in a like manner. After a short time the chlorophyll was all destroyed, and replaced by a brownish-yellow matter. A weak spirituous solution of chlorophyll was soon bleached. The band β is the last to fade; but in an alcoholic solution the change is slow, and the result is the production of a colouring matter giving a spectrum resembling Fig. 4.

Pharmaceutists may take a hint from these observations, and they are more worthy of note from the fact that they bear upon a recent paper by M. Filhol* on the preparation of medicinal tinctures. In that paper the author comes to the conclusion that alcohol is not so good a preservative as it is generally supposed, and quotes experiments to prove that certain immediate principles of vegetable origin alter when dissolved in alcohol. These experiments apply more particularly to the colouring matters and chlorophyll. The chromatic substances of vegetable origin are peculiarly sensitive to actinic and other influences.

It has been, however, practically proved by myself in a few instances that such decomposition does not extend to the active principles of some of the most important tinctures. I will even go further, and state that the principles that M. Filhol has pointed out as so susceptible of change are more easily decomposed in weak spirits. Still, it is self-evident that M. Filhol is correct in attributing a considerable influence to these bodies, when in a state of change, upon other substances. Thus, if an excess of chlorophyll is exposed to actinic influence in conjunction with starch, a solution is obtained that reduces Fehling's solution with facility; therefore, *à priori*, if the tinctural matters which seem to be particularly built up by the actinic influence are equally sensitive to disturbance from the same cause it is probable that they may act as a ferment to substances in contact with them. It may be taken as a rule that, when the active principle of an organic substance is soluble in alcohol, that rectified spirit should be used in preference to proof spirit for medicinal purposes. Tinctures will frequently be procured in this manner which will be very pale in colour, but quite as active, and more permanent in composition.

As some of the matter contained in this paper is not directly connected with my subject, I will, in conclusion, sum up the various results to which I would wish to draw particular attention. The following may be received as established truths:

1. Chlorophyll (the green colouring matter of leaves) is a nitrogenous substance, either itself the direct cause or a phase of that direct cause which produces the metamorphoses of vegetable juices, such metamorphoses being essential to the existence of the plant.

2. In a leaf, or other green part of a plant, chlorophyll is constantly being deposited, and as fast as it is deposited it is being converted into yellow, brown, or reddish products of decomposition, as illustrated by the spectral observations, but during active growth the leaf green is deposited much more rapidly than it

* 'Journal de Pharmacie et de Chimie,' July, p. 22.

is decomposed. I have observed that on the first appearance of spring leaves of such plants as Virginian creeper give, for the first week or so, a spectrum which partakes more of the character of the autumnal leaf. The presumption is that the leaf is not growing actively enough to deposit a superabundance of chlorophyll.

3. In some deciduous plants there is a period when the elaboration of the leaf green is not commensurate with its further decomposition, and the result is frequently the entire destruction of the chlorophyll before the fall of the leaf. The phenomenon observable in plants such as the Virginian creeper, etc., at the close of autumn is due to the fact that the leaves have a power of vitality for some time after the deposition of chlorophyll has ceased, or is proceeding very slowly. Ordinary leaves fall when the chlorophyll is no longer formed, their existence being at an end. The autumnal tints are due to the slower deposition of the leaf green.

4. In dark-coloured leaves, however the natural colour of the chlorophyll may be disguised to the eye, the bands characteristic of this product will be found well marked in the spectra.

To these remarks we may add the following corollary—that chlorophyll is directly concerned in, if not actually the medium itself for, the elaboration of the crude juices, and that it is intimately connected with the amylaceous series of vegetable products.

LABORATORY NOTES.

Preparation of Zinc-ethyl.

The importance of zinc-ethyl as an agent of research renders a rapid and satisfactory method for its preparation a desideratum. When the presence of ether is unobjectionable the following is, in my opinion, the most satisfactory method for the preparation of this substance. It is little more than a modification of Ruth and Beilstein's method. Its success depends on an exact compliance with the following directions.

The zinc which I employ is granulated by pouring it from a height of about 18 feet into water acidulated with hydrochloric acid. Zinc prepared in this manner is much more active than common granulated zinc, even if the latter be freshly etched. The zinc should not be prepared long before it is wanted. After the granulation the zinc is sharply dried. It is made quite hot just before use. The ether is dried over lumps of chloride of calcium. It is then poured on to powdered fused chloride of calcium, and filtered when required. Ether dried in this way, if free from alcohol, will not evolve gas when treated with sodium. The iodide of ethyl is dried in the same manner. A small dry plaited filter is employed in filtering the ethers.

The only other reagent required is a small quantity of zinc-ethyl. This zinc-ethyl may be regarded as a kind of leaven, and great care should be taken not to leave one's self without the few drops necessary to leaven the next supply.

The process of manufacture is very simple. A flask of about 650 c.c. capacity is very carefully dried by heating it and blowing into it with the bellows. Whilst still hot it is about two thirds filled with the hot granulated zinc, and then the iodide of ethyl (about 500 grammes) filtered on to the *hot* zinc. About 60 c.c. of dry ether, to which a little zinc-ethyl has been added, is now poured into the flask, which is then at once fitted to an inverted condenser. The flask is then heated in the water-bath. The reaction commences at once, or, at least, as soon as the contents of the flask have boiled for a minute or two. No advantage is gained by filling the apparatus with carbonic acid. In the course of from one to two and a half hours the reaction is finished. This is known by the mixed ethers no longer dropping back. The common ether does not interfere with this sign, as it forms some compound with the products of the reaction which is not decomposed at the temperature of the water-bath. The water-bath is now removed, and the flask allowed to get somewhat cool. It is then removed from the condenser, and the zinc-ethyl distilled off in the ordinary manner from an oil-bath. The first few grammes which contain much ether may be used for starting the next preparation. I have only to add that the more rapid the reaction is, the larger is the yield, and that the slightest trace of moisture will delay the reaction, even though a sufficient excess of zinc-ethyl be added to destroy the whole of the moisture.

Ernest T. Chapman.

London Institution, June 8.

EDITORIAL NOTES.

CERTIFICATED TEACHERS IN SCIENCE.

The power of acquiring is different from that of imparting knowledge, and the most accomplished scholars often make the worst teachers. The mere passing an examination is not a guarantee of capacity for teaching, nor can anything short of long special training fit most men for this difficult and delicate work. Some have a natural gift for it, while others obtain the power only after long practice. The truth of this statement has been, to a great extent, recognised in our more advanced systems of education; and the old notion, that any one who has been to school is competent to teach has given place to a more enlightened view, which is manifested in the establishment of training colleges for schoolmasters. But, while this opinion has been gaining ground with those who make education their peculiar study, and whose experience and successful labours claim our deference, an educational establishment has sprung up under a sort of

Government sanction which does not admit the necessity of such training, and offers certificates of fitness to teach to any person who passes its examinations, without requiring any further proof that he has in any special way qualified himself for the office of teacher. This principle of the Science and Art Department at South Kensington is bad, and its results are most unsatisfactory. The evidence which we have of the capabilities of its "certificated teachers in science" warrants us in condemning it in strong terms.

Several "certificated teachers" have published scientific treatises which prove that the authors have not gained their knowledge in the laboratory, the only school where chemistry can be properly learnt. Physical science differs from other branches of knowledge, in that it can only be acquired by experiment. Mere book study must partake more or less of the nature of "cram," and can never fix in the mind those principles without a perfect assimilation of which no real proficiency can be attained. The "Organising Master of the Science Classes," whose post, from its pretentious title, should be filled by a highly qualified man, in his 'Elements of Chemistry,' thus represents the decomposition of water by iron at a high temperature:

$$\text{“}\textit{Steam}\ H_2O + Fe = FeO + H_2\ \textit{free}.\text{”}$$

Now, this error is a proof, not only of bad cramming, but of an absence of practical knowledge. No one who had performed the experiment indicated by the equation could possibly have made this blunder. Every laboratory student knows the appearance and instability of FeO. Again, his directions for preparing chloric anhydride by boiling chlorate of potassium with hydrofluosilicic acid, and his remarks on testing, show a similar ignorance. One can hardly think that any but a practical chemist would venture to write on such subjects. We make these remarks, not to call attention to an individual, but to show that the system of which he is a representative, and which contents itself with examination tests alone, is utterly worthless as a promoter of scientific education. We do not believe that the science department is under the direction of those who are competent to deal with scientific education. Among the professional examiners are men of considerable eminence, but they are only examiners, and simply perform the duties assigned to them. Till lately an examination on analysis was required for a certificated teacher in chemistry; this has been abolished, though, from its nature and extent, its loss is a matter of no great importance; still, it shows how imperfectly the South Kensington body understands the requirements of a teacher of chemistry. It really is a serious matter that the public should be misled by shams like this certificate of the Science and Art Department. It is cruel to delude people with the idea that they are learning science from competent masters, when their certificated teachers are really unable to elucidate the simple rudiments.

We know of a "certificated teacher" who, when lecturing to his class on hydrogen, put zinc and strong sulphuric acid into a generating bottle, and, after waiting a considerable time for the evolution of the gas, and adding more sulphuric acid, told his pupils that something was wrong with the apparatus, and that he would show them the experiment next time. But it may be urged that, as accidents happen in the best-regulated families, they may even occur in Mr. Cole's well-ordered establishment. There is, however, a great difference between a mere inadvertence and a mistake resulting from ignorance. A gentleman may, by accident, drop his fork at dinner and soil a lady's dress, but he cannot, by accident, use his fork in place of a toothpick. We fear that the accidents we have alluded to, and many others we know of, which need not be mentioned here, are of the latter kind, and must be attributed to a want of proper training. A medical man, whose business is to keep the body in health, has to pass months in the dissecting room and years in getting a practical knowledge of his profession before he can obtain his certificate to practise; and should those whose work is to train the mind in sciences, deep and abstruse, be certificated on passing an examination which a lad of moderate abilities could prepare himself for by twelve months' study, without handling a test-tube or soiling his fingers in a laboratory?

This is, unfortunately, an age of smattering. The so-called intellectual classes, like the Athenians of old, are restless, and always seeking after "some new thing." A stranger, passing through our great city, would see in its south-west quarter, as an apostle once saw in ancient Athens, "an altar to an unknown god," an altar whereon all that is true and sound in science and art education is being sacrificed to a fatal whim which fosters a miserable craving after superficial knowledge.

USEFUL KNOWLEDGE.

THAT excellent body, the Society for the Promotion of Useful Knowledge, fell into a great mistake when they made the word "useful" so conspicuous a portion of their title. Had they used some such phrase as "natural knowledge" they would, we venture to think, have achieved a much wider and more lasting success; and

had they been bold, and said "useless knowledge," their publications would most probably have already begun to come into use in our great public schools. When it is remembered that so-called "culture" is the great object of general education—that the traditions of centuries have led so many of our teachers to think that in training mental trees the bringing forth of fruit is quite a secondary matter compared with bearing marks of having been carefully trained—no one can wonder that, as confessedly is the case, usefulness seems, in matters of education, to have something of degradation attached to it. There is to the human mind a natural charm in uselessness, especially in the uselessness of useless preparation. Every one at the play is delighted at watching the villain ferociously sharpening a knife which every one knows he will never use. We feel even a fellow-feeling for him, for there is not one of us but is in secret diligently putting an edge to some mental tool which we very well know we shall never have opportunity to employ. And there are many honorable pursuits the virtue of which would entirely and suddenly go out of them if it was for a moment supposed that they were serving any useful end. Certainly at the present day the educational power of useless knowledge is being strained to the utmost, and it is not difficult to see how utterly unseasonable the attempt to introduce natural science into our public education must appear to a rightly constitued scolastic mind. Whatever other effects such a change might have, it would, at least, take away half the charm of teaching.

Such minds as are repelled by the unfortunate usefulness of natural science are, however, apt to forget, or, perhaps, we ought to say, are unwilling to admit, that, over and above the material advantages resulting from a knowledge of the laws and processes of things going on around us, the mere act of acquiring that knowledge affords a large, thorough, and many-sided training, such as can be gained by no other kind of learning. For the sake of getting science acknowledged as a prime agent of education, its friends would rejoice to forget its usefulness, and would, if possible, gladly call it useless. At all events, it is very desirable that the advocates of scientific education should cease to urge the claims of useful information, and should speak of a knowledge of physics and chemistry as if they were of no more practical value in daily life than an acquaintance with the metres of Terence or an appreciation of the full force of the particle μεν. As long as men press upon the public the desirability of every boy knowing the anatomy of his own thorax, with the view of preventing his abusing his respiratory functions, or of every young lady studying the laws of the radiation of heat, as an assistance towards the selection of a teapot, no one can reproach the authorities of our high schools because they make "science," like dancing, an optional study, especially set apart for the weekly half-holiday. Schoolmasters must be spoken to in their own language, and science can never be expected to take rank as a prime study of youth until scientific men agree to look upon all the common usefulness of science as a mere accident, as a thing of no importance whatever, while they insist daily and loudly on the matchless worth of a proper bringing up in matters of physics, chemistry, and biology, as the grandest possible training for a growing mind, whatever be the fate waiting for it in the world at large.

In doing so they will in no wise be unduly magnifying their office. There is hardly an argument in favour of a classical training which cannot be repeated in favour of a scientific training. The study of physics and chemistry, moreover, instead of being antagonistic, is complimentary to that of mathematics, and by its introduction the baneful duality of our present system would be done away with. Does one find in classical training the cultivation of accuracy, of a power of analysis, of a sense of differences, and an exercise of memory? All these things, even much more, abound in a mind scientifically trained. One thing only is wanting to science, and which is, perhaps, after all, the chief merit of classical studies, the being distasteful to youth. Undoubtedly, we should lose, if classics were to disappear from our ordinary academic curriculum, a great deal of the wholesome influence of a compulsory pursuit of things hateful, but practically this could, in all probability, be easily supplied. On the other hand, science has—what classical studies but rarely bring to bear on the minds of the young—a moral element of great intensity. The moral teaching of Greek and Latin is heard by those only who have pursued their studies beyond the limit reached by ordinary schools. No one can soberly entertain the idea that any boy was ever the better for stumbling over the priggish platitudes of Cicero; while those who are touched in heart by the plaintive wails of the Greek tragedians, or the homely truthfulness of the still older poets, are few and far between. Whereas, no one can put his foot even over the threshold of natural science without feeling that the qualities we call moral are the essentials of intellectual success. Obedience, humility, hope, and charity, all these are written in large letters over the door of every chamber of real science. Perhaps of all the uses of so-called useful

knowledge this moral effect is the weightiest and most certain.

Nor is this matter of the introduction of science into our ordinary school teaching a thing which affects scientific men themselves but little. To those whose minds have dwelt on the subject nothing can be more clear than that the best way to enforce a due public recognition of science is to drive the thin edge of the wedge into our schools; but this is too wide a topic for our present limits.

CHEMICAL SOCIETY.

THURSDAY, JUNE 6.*

Professor A. W. Williamson, Vice-president, in the chair.

The meeting was held in the room of the Royal Society, on account of the large attendance of Fellows expected.

The names of visitors introduced by the Fellows having been announced from the chair, the minutes of the previous meeting were read and confirmed. The donations received since the last meeting were enumerated, and the thanks of the Society returned to the donors.

Sir Benjamin C. Brodie, Bart., then rose and commenced his discourse *On Ideal Chemistry*:

He said he had undertaken the very difficult task of explaining an abstruse subject in the brief space of an hour. Up to the present time only the first part of his exposition of the Chemical Calculus had been published, but he hoped to be able soon to present the remaining parts to the Society. His new symbolic system was radically different from the systems previously employed, and involved conceptions that were not included in the actual theory of chemistry. Theory was essential to the existence of chemistry, and chemical symbols could not well be considered apart from the hypotheses that were expressed by them. In the beginning of the eighteenth century the theory of Phlogiston, propounded by Beccher and Stahl, assumed the existence of an all-pervading principle which was transferred from one form of matter to another, and the transference of this principle explained the facts of chemical change. It was easy in the present state of our knowledge to criticise the theories of earlier times, but it was not so easy to comprehend them; and although we might consider the phlogiston theory inadequate as an explanation of chemical phenomena, yet we should remember that while using it Scheele discovered chlorine, that Cavendish was content with it, and that Priestley believed in it throughout his extraordinary career, and died with his old faith unshaken by newer doctrines. The theory of phlogiston was finally expelled from chemistry by Lavoisier, and from his day to the time of Dalton chemists were obliged to work without any theory whatever. As the alchemists worked and collected a number of facts which were afterwards explained by the theory of phlogiston, so chemists at the close of the last century collected the numerous facts upon which Dalton founded his doctrine of Atoms. Davy appeared to have made use of no theory, and to have been content with mere numerical results. In the year 1808 Dalton published his 'New System of Chemical Philosophy,' in which will be found the germ of the notation in use at the present day. In his theory of atoms the conception of combination was much more definite than in the theory of phlogiston. Yet Dalton's theory was really more audacious than that of Stahl, as it was based upon the bold assumption that all material bodies, and, in fact, the whole universe, consisted of inconceivably minute indivisible particles of matter—of bodies that could not come within the sphere of actual observation. Chemists had used this atomic theory, in one form or another, for sixty years; during this time, however, there had been no regular development of the theory. Instead of orderly progression, there had been sudden stages of modification, and thus every method of notation had been built on the ruins of its predecessors. He (Sir Benjamin) had a high admiration for Dalton's theory, but he thought it inadequate for present purposes, and that it could no longer be advantageously used to elucidate the work carried on by chemists. He thought that the time had come for the adoption of some other system of symbolic expression in chemistry, as the theory of Dalton, upon which the existing notation was founded, had degenerated into the gross conception that a chemical compound was comparable to a mechanical arrangement of balls and rods. To bring the modern atomic theory before his hearers, he would merely read a few passages from an article entitled "Glyptic Formulæ," published in a recent number of THE LABORATORY.* [Sir Benjamin Brodie then read extracts from the article, with running comments.] This article, he said, threw some light upon the modern atomic symbols, but the writer of it evidently suspected that the balls and rods described might induce erroneous conceptions. The introduction of these glyptic formulæ, and other contrivances of a similar character, showed that chemistry had got on the wrong tack—off the rails, in fact.

The question, then, was, how were facts to be represented? Any one attacking the old system was bound to furnish a better. This he had endeavoured to do. In his system the exact facts of chemistry were to be expressed by symbols. To this term *symbol* he attached a special meaning. He regarded a symbol as a rigid expression of a fact, not as a figure of an object. All the symbols he proposed to employ were of the same abstract character as those employed in the exact sciences, and were to be looked upon as arrangements of marks adapted to the purposes of thought. It was necessary that every symbol should be accurately defined; that every arrangement of symbols should be limited by fixed rules of construction, the propriety of which could be demonstrated; and that the symbolic processes employed should lead to results that admitted of interpretation. The symbols at present used by chemists were wanting

* Specially reported for this journal.

* See May 4, p. 78.

in precision, and were totally different from those employed in the different applications of the science of algebra. He wished particularly to guard his hearers against the supposition that a chemical symbol had necessarily an arithmetical meaning. The facts of chemistry were of a special character, and the symbols by which they were expressed had consequently a special meaning.

Symbols were of two kinds; there were symbols of things and symbols of operations. In fact, ordinary language was a symbolical representation of things and actions; thus, *dog* was the symbol of a thing, and *beating* the symbol of an operation. Again, symbols might express things and operations simultaneously; thus, the phrase *beating a dog* represented an operation and a thing. The symbol of an operation might also represent a thing. Thus, the symbol a in geometry, in its primary sense, might be regarded as the sign of an operation performed on a unit of length, by which a line was generated; but it might also represent the result of the operation—a line of a certain length. In like manner a as a chemical symbol might be regarded as the symbol of an operation performed on a unit of space, by which a *weight* was generated; hence, in its secondary sense, it might represent a weight. [To illustrate the capabilities of symbols for expressing different facts, Sir Benjamin drew upon the black-board various figures in which a and b represented the operations by which lines of given length were formed. When these symbols merely related to length $+ a + b$ had a totally different meaning from $+ a + b$ when a and b expressed operations which gave lines in certain different directions.]

The introduction of symbols of operations into chemistry was a distinctive feature of his method, which he had accordingly termed the "Calculus of Chemical Operations." His object was to express by means of symbols the operations by which chemical substances were made, or rather those by which *gaseous* matter was made.

The fundamental conception of his ideal chemistry was that all chemical substances were brought into the gaseous condition. The simple relations existing between the combining volumes of different gases had, of course, suggested this foundation for his system. Every gas was measured at 0° C., and at 760 mm. pressure. The two units employed in his system were thus defined:

A *unit of ponderable matter* was that portion of ponderable matter which, in the condition of a perfect gas, at the temperature of 0° C., and under the pressure of 760 mm., occupied the space of 1000 c.c.

The *unit of space* was 1000 c.c., divested of all matter whatever. It might be represented by the symbol 1, and the matter in it was of course 0. Hence the paradoxical expression $1 = 0$, but this meant simply that the unit of space was *space*, and contained no matter. We next required a symbol to represent putting matter into the unit of space; let this symbol be x. $x1$ then represents the operation of putting matter of a certain density into the unit of space at 0° and 760 mm. The same kind of matter at double the density and contained within the same space, but still under the same conditions of temperature and pressure, would be represented by $xx1$ or $x^2 1$; of three times the density by $xxx1$ or $x^3 1$. Again, another kind of matter might be represented by y; then $y1$, $y^2 1$, and $y^3 1$, would signify the unit of space filled with matter of y under its ordinary density, or double or three times this density, but always under the same conditions of temperature and pressure. These symbols might be combined thus, $xy1$ would mean the unit of space filled with x and y at the same time, but under the normal conditions. The symbols then represented weights and kinds of matter: x and y might be said to be operations of combination. Let A be the matter of x and B the matter of y, then x would mean the operation of combining A, and y would mean the operation of combining B. $x1$ then would mean "combine A with the unit of space," and $yx1$ would represent "combine A with B in the unit of space."

By this mode of constructing symbols we might represent such facts as the following:

2 vols. of hydrochloric acid contained the same ponderable matter as 1 vol. of hydrogen and 1 vol. of chlorine;

Or, 2 vols of water contained the same ponderable matter as 2 vols. of hydrogen and 1 vol. of oxygen.

Or, to express similar facts in the language of the calculus—

2 units of space of ammonia contained the same ponderable matter as 3 units of hydrogen and 1 unit of nitrogen.

It was necessary to start with some hypothesis on which to found symbols, and from which they might all be deduced. This hypothesis was, that the unit of hydrogen was a simple weight resulting from one operation. Taking α as the symbol of this unit of hydrogen, made by one operation on the unit of space, then oxygen would have to be represented by a symbol indicating that it was formed by two operations—this symbol was ξ^2. Water was represented by $\alpha\xi$; it was made by two operations, one of which was identical with the operation by which hydrogen was made and the other with one of the operations by which oxygen was made. Hydric peroxide was made by three operations, one of which was identical with that by which hydrogen was made and the other two with those by which oxygen was made. It was therefore represented by $\alpha\xi^2$. Chlorine, $\alpha\chi^2$, was made by three operations; hydrochloric acid, $\alpha\chi$, was made by two operations, one of which was the same as that of hydrogen, and the other one of the three operations by which chlorine was made. Nitrogen, $\alpha\nu^2$, was made by three operations; ammonia, $\alpha^3\nu$, by three operations. These symbols, in fact, were condensed equations, uncombined with extraneous matter.

There were three classes of elements, represented by three kinds of symbols:

Those of the first class were made by one indivisible operation, and included hydrogen, α, and mercury, δ, probably zinc and cadmium, and perhaps some others.

Those of the second class were made by two operations, as oxygen, ξ^2; sulphur, θ^2, selenium, λ^2, and perhaps carbon, but as this last was not certain the element is represented by κ^2.

The third and largest group contained the elements made by three operations, and as an example we might take chlorine, $\alpha\chi^2$, and nitrogen, $\alpha\nu^2$. These were formed by operations which made the elements of the two other classes.

Peroxide of hydrogen, $\alpha\xi^2$, and many other compounds, resembled the elements of the third group, both in properties and in the symbols representing them.

The following list was used to illustrate the formula of elements and compounds:

Symbols of the Units of Chemical Substances.

Unit of space	1
Hydrogen	α
Oxygen	ξ^2
Water	$\alpha\xi$
Peroxide of hydrogen	$\alpha\xi^3$
Sulphur	θ^2
Sulphuretted hydrogen	$\alpha\theta$
Persulphide of hydrogen	$\alpha\theta^2$
Sulphurous anhydride	$\theta\xi^2$
Sulphuric anhydride	$\theta\xi^3$
Sulphurous acid	$\alpha\theta\xi^3$
Sulphuric acid	$\alpha\theta\xi^4$
Chlorine	$\alpha\chi^2$
Hydrochloric acid	$\alpha\chi$
Hypochlorous acid	$\alpha\chi\xi$
Chlorous acid	$\alpha\chi\xi^3$
Chlorosulphurous acid	$\alpha\chi^2\theta\xi$
Hydrochlorosulphurous acid	$\alpha\chi\theta\xi^3$
Iodine	$\alpha\omega^2$
Bromine	$\alpha\beta^2$
Nitrogen	$\alpha\nu^2$
Ammonia	$\alpha^3\nu$
Nitrous oxide	$\alpha\nu^2\xi$
Nitrous acid	$\alpha\nu\xi^2$
Nitric acid	$\alpha\nu\xi^3$
Phosphorus	$\alpha^2\phi^4$
Phosphoretted hydrogen	$\alpha^3\phi$
Hypophosphorous acid	$\alpha^3\phi\xi^2$
Orthophosphoric acid	$\alpha^3\phi\xi^4$
Phosphorous trichloride	$\alpha^2\phi\chi^3$
Phosphoric chloride	$\alpha^2\phi\chi^5$
Phosphorous oxychloride	$\alpha^2\phi\chi^3\xi$
Mercury	δ
Mercurous oxide	$\delta\ \xi$
Mercuric oxide	$\delta\xi$
Mercurous sulphate	$\delta^2\theta\xi^4$
Mercuric sulphate	$\delta\theta\xi^4$
Mercurous chloride	$\alpha\chi^2\delta^2$
Mercuric chloride	$\alpha\chi^2\delta$
Trimercuramine	$\alpha\nu^2\delta^3$
Carbon	κ^{y}
Acetylene	$\alpha\kappa^2$
Marsh gas	$\alpha^2\kappa$
Olefiant gas	$\alpha^2\kappa^2$
Carbonic oxide	$\kappa\xi$
Carbonic anhydride	$\kappa\xi^2$
Alcohol	$\alpha^3\kappa^2\xi$
Ether	$\alpha^5\kappa^4\xi$
Glycol	$\alpha^3\kappa^2\xi^2$
Glycerin	$\alpha^4\kappa^3\xi^3$
Acetic acid	$\alpha^2\kappa^2\xi^2$
Tetrachloride of carbon	$\alpha^2\chi^4\kappa^2$
Chloroform	$\alpha^2\chi^3\kappa$
Chloracetic acid	$\alpha^3\chi\kappa^2\xi^2$
Trichloracetic acid	$\alpha^2\chi^3\kappa^2\xi^2$
Chloride of benzol	$\alpha^3\chi\kappa^7\xi$
Cyanogen	$\alpha\nu^2\kappa^2$
Hydrocyanic acid	$\alpha\nu\kappa$
Methylamine	$\alpha^3\nu\kappa$
Mercuric ethide	$\alpha^5\kappa^4\delta$

What was the meaning of these symbols? Were they the symbols of portions of matter, or did they merely represent imaginary relations between portions of hypothetical matter? The answer was that they were ideal. They represented matters and operations which might exist or not. Thus, the compound nature of some of the elements, which was indicated by their symbols, was at present quite hypothetical, but these bodies might prove to be compound. Large numbers of the elements were unknown in the free state in nature—for instance, hydrogen, chlorine, and, above all, fluorine. So that there might still be simpler forms of matter than those at present known, and they might have all existed in the separate and gaseous condition at one time, and gradually combined to form the substances at present known on the surface of the globe. The spectra of the nebulæ and variable stars had disclosed some curious facts; some of them exhibited only portions of the spectra of well-known elements. Might these not be the spectra of some of the components of those matters which we, in the present state of our knowledge, regarded as simple bodies? Might they not, in fact, be some of those prime factors which had been represented by the symbols χ, ν, ξ, θ.... Another system of symbols might have been constructed in which the unit of hydrogen would be represented by α_2, and the formulæ would then have held a simpler relation to the existing system of chemical symbolism, but there were strong reasons for preferring the use of the system in which α was employed to represent the standard amount of matter.

The Chairman then invited the members and visitors present to discuss the important paper which Sir Benjamin Brodie had brought before them.

Dr. Frankland said he thought that the bringing forward of these new notions would do much good. As his name, however, had been mentioned by Sir Benjamin Brodie, when criticising the glyptic formulæ, he must emphatically protest against the implied charge that he viewed these formulæ as material representations of chemical compounds. He did not think that either glyptic or graphic formulæ represented the actual position of the atoms in chemical compounds; indeed, he did not believe either in the existence of atoms or of centres of force. He with many chemists had been dissatisfied with existing chemical formulæ, as by them we could not represent the *force* existing in the compounds, or of the force employed in the formation of these compounds. He said that if we gave up the present formulæ, which had a statical signification, we should be disappointed in not finding dynamical facts represented by Sir Benjamin's formulæ. He objected to the proposed formulæ, as he thought that they did not indicate so

many important chemical facts as those of the present system—for instance, in nitric acid. there was a quantity of hydrogen which could be taken out in one piece, and in one piece only, while in sulphuric acid the hydrogen could be taken out in two pieces. This fact was expressed in the formulæ HNO_3 and H_2SO_4; but in the new formulæ for these two bodies, viz. $\alpha\nu\xi^3$ and $\alpha\theta\xi^4$, he could not perceive that this fact was represented. He did not think that harm would arise from the use of crude representations of chemical compounds if they were properly explained. It was agreed by all that hypothesis was necessary in founding a chemical symbolism, and the proposed formulæ would, therefore, be well recommended, as they rested upon a very fair amount of hypothesis.

Mr. Davey read a paragraph from Sir Benjamin Brodie's printed paper, which asserted that the new system could not be deduced from any existing system. He said that he was in a position to contradict this statement, for it was quite possible to deduce these new formulæ from those of the old notation by the aid of a few simple rules.*

Mr. J. A. R. Newlands asked Mr. Davey how he could deduce Sir Benjamin's formulæ of iodine, nitrogen, and bromine from the symbols in the old notation.

Mr. Davey replied by repeating his rule.

The Chairman said that he could not permit such discussion, as the meeting was considering the formulæ of Sir Benjamin Brodie, and not the notions of Mr. Davey.

Mr. Clerk Maxwell said that on coming into the room he was shocked by finding that space was a chemical substance, and that hydrogen and mercury were operations. The lecturer had, however, removed that impression. With reference to his own investigations, he might say that he commenced without any molecular theory as a basis, but subsequent work had convinced him that some such theory was indispensable; and he now held, in common with Clausius, not only that molecules existed, but that we should one day be able to count the number which occurred in a given volume of any gas. Such molecules were supposed to be extremely small, but not hard; they were also taken to be in constant motion. Chemical formulæ were, no doubt, capable of further improvement, but much had already been effected by their use in skilful hands. Molecular notions were rapidly extending to all the various branches of physics.

Professor G. Stokes, who rose on the invitation of the Chairman, said that the lecturer and himself had given much attention to this point—whether the system should be founded on α or α^2. They had decided on the former, because it was more convenient and, probably, universally applicable. He felt desirous of explaining how some of the symbols had been arrived at, but felt that time would not allow of his entering into the necessary details.

Professor Wanklyn remarked that Sir Benjamin's system was a one-volume method, while the ordinary notation was a two-volume one.

Dr. Odling said that he was shocked to hear that Dr. Frankland did not believe in the evidence of atoms. He thought that all chemists should give attention to Sir Benjamin's calculus as a method of investigation. At present we had only a proof of the accuracy of its expression, and he hoped that its use and advantages would soon be published. It was based on facts and operations, and so possessed advantages over the old methods which were based on the atomic theory. The new method was a one-volume system, but without fractions, and the law of even numbers no longer existed in it.

Mr. E. W. Brayley thought that one of the most important parts of the method had not been adverted to in the discussion, namely, that it shadowed forth new elements. He thought that those present would be glad to understand the meaning of α in the symbols of the haloid elements.

Professor Foster thought that it was interesting to observe that, by reasoning, it appeared that some supposed elements were really compound bodies. Potassa, soda, and their congeners, were examples of substances which were well known to be compound before Davy's discoveries. Again, chlorine was thought to be compound, and hydric chloride was placed by the older chemists in a position intermediate between hydrogen and chlorine: in the proposed notation the same conclusion re-appeared:

$$\alpha \qquad \alpha\chi \qquad \alpha\chi^2.$$

The new formulæ at first sight did not seem to express quite so much as the ordinary notation; but in the case of water, $\alpha\xi$, the symbol ξ, by the fact of its association with α, showed that the hydrogen was distributed and might be removed in two stages; but in hydrochloric acid, $\alpha\chi$, the χ, in like manner, showed that the hydrogen was not distributed, and could only be removed at one stage.

The Chairman thanked Sir Benjamin Brodie for bringing before the society an account of his laborious work of many years. It was so difficult to separate one's ideas from all old things that it would be some time before it was rightly appreciated. But there was no consistency in our present system, and he considered that the new notation would mark an important era in chemical investigation.

Sir Benjamin Brodie, in replying, said that he hoped to be able to express by formulæ dynamical facts; but he could not enter into the subject at that time. His formulæ must be taken as a whole when considering the special properties of any one symbol. Several of the points raised it had been impossible for him to allude to in his discourse; but they had all received his previous attention.

The meeting then adjourned till June 20, when papers by Dr. Gladstone, Mr. Perkin, and others, will be read.

Abstracts of Foreign Papers:—Our readers will miss the usual weekly collection of articles from foreign sources by Henry Watts, B.A., F.R.S., and E. J. Mills, D.Sc., in the present number. In order to do justice to the important meeting of the Chemical Society, we have been compelled to omit these contributions. We will print an extra number of these interesting abstracts next week.

* These rules were read; but as they are given in Mr. Davey's own words on another page, we need not reproduce them here.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *June* 10.

Chemical Society of Paris—Conversazione at the Conservatoire des Arts et Métiers—Organisation of this Institution—List of Professors—Process of Engraving by Dulos—Academy of Sciences.

AT the meeting of our CHEMICAL SOCIETY on the 7th inst. a communication from M. Déhérain on *potassic manures* was read.*

In the course of his communication M. Déhérain remarked upon a fact which indicates an imperfection in a method generally adopted in analytical chemistry. He states that plants grown in a soil which, on analysis, has been found free from phosphates, frequently contain phosphoric acid. He thinks that minute quantities of phosphate of lime may be precipitated together with the oxalate, and thereby escape observation. A different method should, therefore, be employed to ascertain the presence of phosphates in soils.

M. Friedel reported on a *compound of silicon* recently analysed by M. Ladenburg and himself. By allowing a current of sulphuretted hydrogen gas to pass through chloride of silicon, so as to get saturated with this compound, and then through a tube heated to redness, M. Isidore Pierre has obtained a compound which he represents by the formula $SiCl_2S$, taking Si as triatomic and S as monatomic. With the new atomic weights for silicon and sulphur, this formula cannot be expressed in a rational manner. The compound has, therefore, been prepared anew by MM. Friedel and Ladenburg. 250 grammes of chloride of silicon yielded 80 grammes of a liquid, half of which consisted of unaltered chloride, boiling between 59° and 67° C., while 20 grammes passed over between 95° and 97°, and only 5 grammes above 97°.

This compound contains—

$$Si\ 16{\cdot}96;\ S\ 19{\cdot}21;\ Cl\ 63{\cdot}20 = 99{\cdot}37.$$

The authors thought that their product might contain an atom of hydrogen, and they have succeeded in finding their supposition confirmed. They measured the volume of hydrogen of the compound by heating it in a tube, the closed end of which contained carbonate of manganese, while the other end contained metallic copper and communicated with a cylinder filled with mercury and potassa. They proceeded, therefore, just in the same manner which serves for the volumetric determination of nitrogen. They arrived at the same result in making a combustion of their compound and determining the hydrogen by weight.

The formula thus obtained is $SiCl_3HS$, corresponding by methylic alcohol CH_3HO.

This compound produces with alcohol an ether, the composition of which is not yet known with certainty. The compound of M. Pierre (boiling above 100°) is most likely a mixture.

M. Jungfleish communicated to the society his observations on the *specific volumes of chlorinated benzols*, read before the Academy some weeks ago. He also reported on his researches on *chloride of phenyl*. Sokoloff described this compound as being different from monochlorinated benzol, viz. a liquid yielding nitro-compounds differing from those obtained with the latter body. According to M. Jungfleish, these compounds are the same, crystallising in large crystals, which, according to the observations of M. Des Cloizeaux, are perfectly identical. More details will be given later on.

The President (M. Debray) read a note of M. Le Coq de Boisbaudran on the *separation of copper from cobalt, nickel, and zinc.* The author converts these metals into sulphates, and precipitates the copper by galvanic action on a piece of platinum foil. His method is quantitative, and seems to give good results.

On the same evening a conversazione took place at the CONSERVATOIRE DES ARTS ET MÉTIERS, and, as no other place offers equal attractions for such a gathering, large crowds of ladies and gentlemen were seen pouring in and out of the lofty old building. Vaucanson, the great French mechanist of the last century, whose celebrated automatons are not more ingenious than his spinning and weaving machines for silk, opened in 1775 a collection of machines in his house, Rue de Charonne, Faubourg St. Antoine. This collection he bequeathed to his country. Government bought the house and increased the museum, so that, in 1792, three hundred new machines had been added to it. During the Revolution many similar objects found in castles, convents, etc., formed a valuable addition, and in 1795 the fine old convent, St. Martin des Champs, became the home of these collections, and was called the Conservatoire des Arts et Métiers, three "demonstrators" being appointed to explain the museum to the public. Later on the building was tastefully restored by M. Vaudoyer. The old church was appropriated for large machines, and water- and steam-power was provided to set them in motion three times a week. The old refectory of the monks was changed into a library containing the most valuable books and drawings on industrial subjects. Jacquard's original weaving machines, Pascal's calculating machines, Lavoisier's chemical apparatus, Buffon's mirrors, Leroy's and Bregnet's clocks; autographs from Newton, from Galileo, Montgolfier, Jacquard, and many other great philosophers and great inventors were gradually added, and the collection thus became of the greatest historical and practical value. The geometrical models of Monge were added, and the celebrated physicist, Pouillet, director of the collections from 1830 until 1849, increased the museums by very numerous models of modern machinery. To-day from 8000 to 10,000 objects are exhibited in the Conservatoire. A collection of dynamometers is not only exhibited but is turned to good account. These instruments are in actual use, and everybody is allowed to have his machines tested with them. So, just as gold and silver are hall-marked at the Mint, or weights and measures inspected by the proper authorities, the power of

* An abstract of the author's communication to the Academy, on the same subject has been given in this correspondence. See LAB., May 25, p. 134.

machinery may be submitted to the tests of M. Tresca, sub-director and engineer of the Conservatoire des Arts et Métiers. Another measure to increase the value of this institution, anterior to the one we have just mentioned, was that by which professors were attached to the museum. These professors give lectures on Sundays, intended chiefly for working men, and evening lectures on week days. The following subjects are now treated by very able, and some of them very eminent, masters:

Mathematics applied to the arts,	by M. Laussedat.
Descriptive geometry,	„ „ De la Gournerie.
Constructions,	„ „ Trelat.
Mechanics applied to the arts,	„ „ Tresca.
Spinning and weaving,	„ „ Alcan.
Physics applied to the arts,	„ „ E. Becquerel.
Chemistry,	„ „ Peligot and
	„ „ Payen.
Chemistry applied to agriculture,	„ „ Boussingault.
Printing and dyeing,	„ „ Persoz.
Agriculture,	„ „ Moll.
Agricultural machinery,	„ „ Hervé-Mangon.
Political economy,	„ „ Wolowsky.
Statistics,	„ „ Burat.

MM. Peligot, Payen, Boussingault, and Persoz, has each a laboratory allotted to him in the building open for pupils. The library contains all expired patents, and it is to be hoped that a patent office similar to that in Southampton-buildings will be added to it in the course of time.* It is contemplated to open model workshops in the building containing the best and newest tools.

General Morin, who is at present director of the Conservatoire, is known through his improved system of ventilation, applied to the lecture hall of the building and to several new theatres of Paris. An ingenious instrument indicates constantly the amount of fresh air entering the room. He succeeded M. Pouillet in 1849, who was deposed because he allowed the opposition members of the Legislative Assembly to assemble in the great lecture room, whence they were driven by military force.

The collections may be compared with those of the South Kensington Museum, which has the advantage of its art collections, wanting in the Conservatoire. The Paris museum, however, has more machines and valuable models, and these are arranged in the most appropriate manner in numerous and elegant rooms.

The church, the refectory, and the great staircase, are particularly handsome. On the occasion of the conversazione electrical lamps and innumerable gas jets poured a flood of light through the whole building. In addition to the ordinary collections many new machines and apparatus were shown, of which we may mention Ladd's new electrical motor, several air machines and gas machines; Bonelli's autographic telegraph, now in use between Paris and Lyons (producing drawings, etc.); Foucault's isochronic pendulums, several new electrical clocks, Carré's ice-machines, and objects connected with Dulos' new method of engraving.

* All new patents are now in the building of the Ministry of Commerce.

This ingenious process, based upon chemical principles, may thus be shortly explained. The drawing to be engraved is made on a copperplate with varnish. The plate is then put into a bath of chloride of iron and chloride of ammonium, from which an electrical current passing through it deposits metallic iron on the copper. The varnish is then removed, and the plate, which now exhibits a copper drawing on an iron ground, is exposed for some moments to a silver bath, from which silver is deposited on the copper only. After being perfectly dried, the plate is then covered with mercury. This will only adhere to the silver, forming a strange kind of liquid basso-relievo over the orginal drawing. Curiously enough, the liquid metal sticks to the silver sufficiently fast not to change its place when molten wax is poured on it. An exact impression of the drawing is thus produced on the wax. This, after being removed from the copper plate, is then covered with graphite powder, and a new copperplate produced from it by the ordinary electrotype process. This plate may be used without further trouble for reproducing the drawing in print. Very fine prints produced by this method witnessed to the excellence of M. Dulos' invention.

At the meeting of the Academy of Sciences of the 3rd inst. no paper of chemical interest was read. The meeting opened late, the council and many of the members of the Academy having been assisting at the burial of their late colleague, M. Pelouze. The President opened the proceedings with a short account of the mourning ceremony. M. Fremy in the name of the Academy, M. Dumas in the name of the Municipality of Paris, and M. Marcotte in the name of the Board of the Mint, spoke over the grave of the deceased.

The election of a new member of the medical section was severely contested. Three elections had to take place before one of the candidates had collected the necessary number of votes. This was M. Nélaton, who obtained 32 votes against 26 given to M. Langier.

M. E. Becquerel deposited on the table of the Academy his new treatise on light, '*La lumière, ses causes et effets*.' It contains his researches on phosphorescence and on the chemical action of light.

M. Rosenthal published a note on the *poisoning action of strychnine*. The cramps produced by strychnine discontinue when large quantities of air or oxygen are introduced into the lungs of the poisoned animal. They reappeared with renewed vigour as soon as the artificial respiration is interrupted.

M. Chautard communicated a method of making the diamagnetism of gases visible in the lecture-room. He imprisons the gases in soap-bubbles, which between the poles of an electro-magnet take the direction of diamagnetic solids. The same may be observed with the fumes of burning magnesium.

M. Pasteur published two letters, and M. Vasco and M. de Mouchy publish a note each, on the disease of silkworms. Although of physiological nature, these researches will be reported upon in a future letter.

PARIS UNIVERSAL EXHIBITION.

CLASS XL.—MINING AND METALLURGICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *June* 9.

Unsatisfactory arrangement of Class 40—Manufactures in Platinum and allied metals—Magnesium—Sodium-Amalgam—Crookes's Gold-Amalgamation process—Pure Hydrate of Sodium—Iron.

CLASS 40, which is supposed to contain mining and metallurgical products (*Produits de l'exploitation des Mines et de la Metallurgie*), is another glaring instance of the absurdity of classifying products according to their origin rather than according to their use. In Class 40 we have the veriest hodge-podge, an utterly uncongruous mixture of the most dissimilar articles, completely throwing into the shade the confusion that reigns in Class 44, to which we made allusion in our last number. One of the first objects we meet on entering the class is a case of pins and needles, further on some specimens of pig iron, then some very beautifully wrought door-handles; these are followed by footbaths, plumbago crucibles, brass hinges, iron ores, chisels and files, *spiegeleisen*, coal-scuttles, sodium-amalgam, horse-shoes, etc. etc. In fact, if ever there was an instance of classification run mad, it is to be found in Class 40 of the Paris Universal Exhibition.

The same want of arrangement is also to be met with here as in Class 44. As if it were not sufficient that the most distinct articles should be classified together, those who have had the charge of arranging the class have dotted the cases about in the wildest confusion. First we have a series of specimens of iron ores, then pins and needles, next to them come mineral oils, and fourthly we have iron ores again; in fact, the greatest pains seem to have been taken to separate as much as possible the members of the same groups of products. This is surely not as it ought to be, for it takes but a small amount of technical knowledge to know and understand that exhibitors of iron ought to be placed close to each other, so that their products may be compared as well as examined individually. It is hard to know whom to blame in this matter, for the committee of the class includes a number of scientific and practical men, whose names leave no doubt of their ability, and they surely could hardly have suspected that such absurdities would have been committed in the arrangement of the class. The general French classification, of course, could not be altered, but those who exhibited similar products ought to have been placed together.

As might have been expected, Messrs. Johnson and Matthey make a display of platinum, both in the ingot and in the manufactured condition, that far exceeds anything ever before exhibited. It is truly a show that places them in the position of the first platinum workers in the world; but we must not forget that the excellence of their manufactures depends in a great measure on the invention of a Frenchman—we, of course, allude to the oxyhydrogen furnace of H. St. Clair Deville. First of all come two gigantic platinum boilers, one capable of distilling eight, the other five, tons of sulphuric acid per day. These boilers are put together by the autogenic process, which, we believe, is practised only by Messrs. Johnson and Matthey. By this method, which consists in fusing the edges of the platinum together by means of the oxhydrogen blowpipe, a perfect union is obtained, and the whole boiler becomes, to all intents and purposes, a single piece of metal. Formerly platinum was always soldered together with gold, but even with the greatest skill and care a perfect joint could not always be obtained. Belonging to them are series of refrigerators and other apparatus, all manufactured with the greatest possible skill. Beneath these platinum giants we find crucibles, tubing, evaporating dishes, small retorts, plate, foil, rod and wire, lightning conductor tops, bits for horses, gauze for jewellers' use—in fact, every conceivable article that has ever been made of platinum. There is also a large ingot of the metal, and a model of an ingot weighing nearly a hundredweight—the largest mass of platinum ever seen—which was exhibited by this firm in 1862. A model of a platinum worm made for Messrs. Cross and Blackwell for the purpose of boiling the vinegar used in the manufacture of pickles, is an instance of the rapid spread of scientific knowledge amongst all grades of manufacturers. This worm, which is an inch and a half in diameter, and measures over thirty feet in length, will boil 325 gallons of vinegar in three quarters of an hour, under pressure of two atmospheres. Messrs. Johnson and Matthey also show iridium in the ingot, also the metal cut with diamond dust; an alloy of iridium and platinum, which is now coming into use for the touchholes of ordnance and nipples of small arms, a fine piece of native osmiridium, specimens of osmium, rhodium, palladium, ruthenium, and several other of the precious metals. An exceedingly interesting series of metals, illustrating visibly their various specific gravities, is also shown by them. This is done by casting one kilogramme of each metal in the cylindrical form, each cylinder, of course, having the same diameter. Amongst them are magnesium (quite a pole of metal as compared with the squab stump of iridium), aluminum, osmium, iridium, palladium, thallium, as well as the common metals. In another case Messrs. Johnson and Matthey show a series of specimens illustrating the refining of gold and silver. They exhibit silver in the rough ingot, as it comes from Chili and Peru, and a long range of glass jars show every step of the process of refining, from the crude metal to the completion of the operation. In one of our first articles on the Paris Exhibition we stated that neither aluminum, magnesium, nor sodium, were shown; but we were in error, pardonably so, perhaps, for we should hardly have thought of looking for these metals amongst hammers and buttons. The firm whose products we are considering show aluminum in the form of a boiler, which is intended to be used by Messrs. Cross and Blackwell for boiling fruit for preserves. Magnesium is also shown by them in riband and wire, in powder for

use in Larkin's magnesium lamp, and chemically pure in rods as a substitute for zinc for toxicological purposes. Sodium is shown in the form of amalgam, which is used in large quantities in Crookes's well-known process for the prevention of loss in the extraction of gold and silver from their ores. It is generally exported in the concentrated condition, and diluted with the necessary amount of mercury at the mine. A few figures will, perhaps, illustrate the value of this ingenious invention. A particular sample of gold ore gave the following results under three modes of treatment:

By ordinary process...2 oz. 16 dwt. 0 gr. per ton.
By Crookes' process...7 oz. 0 dwt. 6 gr. per ton.
Laboratory assay ......7 oz. 9 dwt. 0 gr. per ton.

One of the most interesting specimens shown by Messrs. Johnson and Matthey is a sample of perfectly pure hydrate of sodium, made from the metal itself. They state that it can be manufactured at a very cheap rate, and will easily take the place of chemically pure soda made by the ordinary process. This can be readily understood when we consider that sodium may be bought in the market at about 12s. per lb. in quantity. There is also a specimen of chromium in the case, but a huge carpet being in front of it effectually prevents its examination. The way in which Messrs. Johnson and Matthey show their manufactures ought really to be taken as an example by certain very careless exhibitors in Class 40, who appear to think that it is only necessary to place a specimen of their productions on a more or less untidy table or stand and allow the dust to accumulate upon it. Others, again, paste meagre descriptions, in small and sometimes utterly illegible handwriting, on their articles. This is not the way to exhibit. If a product is worth exhibiting it is surely worthy of being legibly and neatly labelled with a proper description, and of being covered with a decent glass case. We make these remarks because we have been frequently puzzled to know what the particular article was that we were examining, and on one occasion, when we took the audacious liberty of dusting a piece of iron ore, in order to see what it really was, we were threatened with all kinds of pains and penalties by a very fierce and voluble *sergen de ville*. In Messrs. Johnson and Matthey's case every object has a legibly printed description attached to it, both in English and French.

Passing to the other end of the class we commence our examination of Earl Dudley's splendid display of iron, which deserves almost as much praise for its arrangement as for its almost unparalleled excellence. As far as the Staffordshire district goes, his lordship undoubtedly stands at the head of the iron trade, a position he owes to his own enterprise and generosity in carrying on his business, and to the talent and energy of Mr. Richard Smith, the manager of his mines, furnaces, and forges. The specimens shown in Class 40 by Lord Dudley seem to indicate that very little alteration has taken place in his famous BBB iron since Mr. Smith has retired into private life, and that his relatives and successors are as talented and energetic as he was. The series begins with specimens of the coal, limestone, and ore, found on his lordship's estates. These are followed by pig iron of excellent quality, and an infinity of samples of wrought iron of every shape and size. Some of the homogeneous bars give a fracture that can be compared with anything shown in the class, and the fibrous iron merits the same praise. A series of bars of fibrous iron are shown which were lately tested by Messrs. Cochrane, Grove, and Co. The ordinary quality broke at a strain of 23¾ tons on the square inch, while the enormous force of 32½ tons was required to break a piece of the *best, best, best*, cold-rolled iron of the same sectional area. Here, again, we must bestow praise on the way in which the products are shown, every sample being legibly described in four languages.

Above the case are a number of round bars tied cold into knots, twisted into spirals, and otherwise tortured out of their primitive shape. There has been a great deal of talk about England having been beaten by various Continental nations in machinery and other products for which she was always famous. Whether this be so or not with machinery we are not called upon to say, but we venture to affirm, after a close examination of all the iron in the Exhibition, that there is very little that comes up to Lord Dudley's in quality, and that there is none made with similar disadvantages as to ore and fuel that even approach it.

Lord Granville also shows a fine series of specimens of coal, ore, limestone, and pig and wrought iron, from his lordship's works at Lillenhall. The "blackstone" and "battstone" exhibited in the series appear, as far as one can judge without an analysis, to resemble the gubbin ironstone found on Earl Dudley's estate. By the way, it would very much increase the interest of such displays if the average composition of the ores used were appended to the specimens—indeed, for the chemist, who looks on things with an analytical rather than a synthetical eye, it is a *sine qua non*. The coke-made iron wire seems of excellent quality; it would, however, be interesting to know what weight a given sectional area will support. While speaking of wire we may mention that a German exhibitor of this article has gone to the trouble and expense of erecting two testing machines, so that his wire may be tried on the spot. This is carrying matters rather too far in the direction of over-exhibiting a product.

The Lowmoor Company also show a fine series of products. Some of the iron-bars cold-twisted seem to equal some of Lord Dudley's in their freedom from any sign of fracture.

The Bouling Iron Company show iron of excellent quality, also a fine cast-steel shaft, also weldless wheel-tires and hoops.

Messrs. Moon and Manby's series of sections of rolled iron are more interesting to the engineer than to the metallurgist or chemist.

John Brown and Co., of Sheffield, make but a poor show, at least for a house having such a well-earned reputation. They exhibit a number of cast- and wrought-steel articles, such as axles and springs. In the British artillery shed, however, in the park is a noble specimen of a 13-inch armour-plate shown by this firm.

CORRESPONDENCE.

BLACK-BALLING AT THE CHEMICAL SOCIETY.

To the Editor of THE LABORATORY.

SIR,—In your number of May 18 Prof. Wanklyn, defending the late black-balling at the Chemical Society, says, "I will only add, in conclusion, that the ten or twelve young men (at any rate, the eleven black-ballers) included one who has within the last few weeks presided at the Chemical Society." I am given to understand that I am the person alluded to.

If it had been so, and Mr. Wanklyn had taken the trouble to ascertain the fact, he would still have had no right to publish it without my consent. Such, however, was not the case. I did not vote against any candidate at either of the meetings on April 18 and May 2.

I am, Sir, your obedient servant,
J. H. GLADSTONE.

17, *Pembridge Square, June* 10.

SIR B. C. BRODIE'S CHEMICAL SYMBOLS.

To the Editor of THE LABORATORY.

SIR,—The following passage occurs in Sir B. Brodie's paper on "The Calculus of Chemical Operations," 'Phil. Trans.,' part ii, 1866, p. 858:—"Now, as no symbolic system similar to the present has yet been devised, and as *this system cannot be deduced from any existing system*, every symbol not only makes an assertion, but expresses a discovery as to the chemical properties of the substance symbolised." At the last meeting of the Chemical Society Sir B. Brodie admitted, however, that his notation can be deduced from the usual one; and it may not be uninteresting to notice how *very simply* this may be effected.

Rules for writing off-hand, without the aid of the "Calculus," the New Symbolic Notation.

For the elements:

1°. Let "α" represent hydrogen.

2°. Let the initial or other letter in the Greek name of the element be the characteristic in the new symbol.

3°. Write a little 2 as index to the characteristic letter.*

4°. When the element can combine with an odd number of units of hydrogen, prefix an "α" to the symbol.

For compounds:

5°. Substitute for each of the elementary symbols in the old notation the corresponding new Greek symbol, and multiply its indices by the coefficient of the old symbol.

6°. Add the indices of all like symbols together, and then divide them by 2.

For example:—In chlorine (by 2° Rule) χ will be the characteristic; write a little (2) above the χ, χ^2 (3° Rule); and (4° Rule) prefix "α," and we thus obtain $\alpha\chi^2$ as the symbol of chlorine.

To express hydrochloric acid in the new notation:

By 5° Rule we have $\left\{\begin{array}{l} H = \alpha \\ Cl = \alpha\chi^2 \end{array}\right.$

" 5° " $\alpha^2\chi^2$, and, after dividing the indices by 2, we obtain $\alpha\chi$ as the symbol for hydrochloric acid.

The chief points of difference between this new *notation* and the one in daily use are the substitution of Greek for Roman letters, and the implied assumption that one litre of hydrochloric acid contains one litre of hydrogen. We were told that one great merit of the new system consisted in its rigid adherance to facts, of which the above may be cited as an example.

I am, Sir, your obedient servant,
R. R. F. DAVEY.

War Office, Pall Mall.

* Except for expressing the *elements* phosphorus and arsenic, the indices are doubled, and for mercury and cadmium they are halved. However, to symbolise the compounds of these substances the above rules hold good.

VARIA.

We are given to understand, on good authority, that Dr. Lyon Playfair will probably be selected to represent the University of Edinburgh in Parliament, provided the Scotch Reform Bill passes. Amongst the candidates for the representation of the London University Professor W. A. Miller and Sir John Lubbock are mentioned.

The following letter is printed in the columns of the 'Lancet:'—"Sir,—Permit me to call your attention to an advertisement which appeared in the 'Philosophical Magazine' for April, respecting which some explanation seems desirable. It is headed, 'University College: June Matriculation Examination of the University of London;' and announces a course of Chemistry by Professor Williamson, F.R.S., assisted by Mr. C. H. Gill, F.C.S.,—the course to consist of about twenty lessons in Practical Chemistry, and as many oral lessons. The fee is mentioned. A reference to the Calendar shows that Professor Williamson is the gentleman who will *examine* in Chemistry at the June matriculation of the University of London. Were I about to matriculate, I should certainly enter the Professor's class, and should be diposed indeed to think that anyone who did not avail himself of this convenient arrangement deserved rejection. But this is from the student's point of view, which is somewhat prejudiced. The Senate of the University is probably not aware that intending candidates for matriculation from all sides are thus invited to enter the class of their future examiner. Or is this a plan by which it is sought to mitigate the well-known severity of the University examinations?—I am, sir, your very obedient servant, INQUIRER." There can be little doubt that "Inquirer" is a public teacher of chemistry.

CORRESPONDENCE ANSWERED.

A. Ramsay, junr. There are many misprints in Dr Williamson's 'Chemistry for Students,' but you may depend upon the correctness of the calculations given in the work. Your own calculations are based upon an absurd misconception of the relation of the cubic centimetre to the cubic decimetre.

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

MEETINGS FOR THE FORTHCOMING WEEK.

JUNE.

Wednesday, 19. Meteorological Society. 8 p.m.
Geological Society. 8 p.m.

Thursday, 20. Royal Society.. 8.30 p.m.
Chemical Society. 8 p.m.
Mr. Perkin, *On the Derivatives of Hydride of Salicyl.* Dr. Phipson, *On Analysis of Biliary Concretion.* Dr. Gladstone, *On Pyrophosphoric Acid.*

Friday, 21. Royal Institution. 8 p.m.
(Extra Evening Meeting).
Professor Tyndall, *On Some Effects of Sonorous Vibration.*

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1857, Dec. 17.

THE LABORATORY:

A Weekly Record of Scientific Research.

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CONTENTS.

THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science. Though only ten numbers of THE LABORATORY have as yet appeared, many well-known names may be mentioned in conjunction with its articles, as will be seen by the following list of the principal contributors:

A. Matthiessen, Ph.D., F.R.S., Lecturer on Chemistry at St. Mary's Hospital.
W. H. Perkin, F.R.S.
Maxwell Simpson, M.D., F.R.S.
Henry Watts, B.A., F.R.S., Editor of the new 'Dict. of Chemistry,' &c.
C. Greville Williams, F.R.S.
E. J. Mills, D.Sc.
G. C. Foster, B.A., Professor of Experimental Physics, Univ. Coll., London.
Michael Foster, M.D., Professor of Chemical Physiology, Univ. Coll., London.
J. A. Wanklyn, Professor of Chemistry at the London Institution.
William Dittmar, Principal Assistant in the Laboratory of the University of Edinburgh.
Herbert McLeod, Chemical Delegate to the Paris Exhibition.

C. W. Quin, F.C.S., Superintendent of the Chemical Classes of the Exhibition of 1862.
C. R. C. Tichborne, Chemist to Apothecaries' Hall of Ireland.
F. S. Barff, M.A. Cantab., F.C.S.
E. T. Chapman, F.C.S.
H. N. Draper, F.C.S.
J. Ferguson, M.A.
C. Hockin, M.A., Fellow of St. John's College, Cambridge.
C. Lauth, Paris.
A. Oppenheim, Ph.D., Paris.

To the above list may be added the names of some of the eminent writers whose articles will shortly appear:
A. Kekulé, Ph.D., University of Ghent.
Father Seochi, Director of the Observatory at Rome.
A. Naquet, Paris.
Georges Salet, Paris.
Robert Galloway, F.C.S., Professor of Practical Chemistry, Museum of Irish Industry.
Thomas Richardson, Ph.D., Lecturer in Chemistry, University of Durham.
W. M. Watts, D.Sc., Principal Assistant in the University Laboratory, Glasgow.
A. F. Marreco, F.C.S.
Rev. J. H. Jellett, M.A.
H. B. Brady, F.L.S., F.C.S.
Emerson Reynolds, M.D.

Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzo-salicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *Geber*, an Historical Study.

Among the principal Editorial Articles are the following:—*Titular Letters; Proposed Amendment of the Pharmacy Act; The British Museum Reading Room; International Banquet at Paris; Glyptic Formulæ; The Wages of Science; Position of the Analytical Chemist; A Chemical Diploma; Hall of Arts and Sciences; Industrial Education; Certificated Teachers in Science—Useful Knowledge.*

Critical Reviews of the following important books have appeared:—*Noad's Text-Book of Electricity: Kühne's Physiological Chemistry; British Pharmacopœia; Bloxam's Chemistry; Brande's Dictionary of Arts and Sciences.* Numerous minor works have been noticed.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

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Back Numbers can yet be obtained.

PARIS UNIVERSAL EXHIBITION.

THE BRITISH COLONIES.

BY C. W. QUIN, F.C.S.,
Superintendent of the Chemical Classes of the International Exhibition of 1862.

QUEENSLAND.—Small display of minerals. SOUTH AUSTRALIA.—Copper, lead, bismuth, and silver ores. NEW SOUTH WALES.—Gold display of the Exhibition Commission—Collection illustrating the geology of the gold-fields—Collection illustrating the geology of the coal-measures—Coal—Kerosene shale—Native alum—Chemical products. NATAL.—Coal, ores, and other mineral productions.

PARIS; *July* 1.

ON the present occasion Queensland, the youngest of our colonial possessions in Australia, seems to have confined her attention principally to showing her capabilities for growing cotton, wool, tobacco, and other agricultural produce. A few specimens of gold and gold quartz are shown along with a necklace of stones called Australian diamonds. They are, of course, only pieces of quartz or, possibly, white topazes, and should not have received the name bestowed upon them, more especially as true diamonds are found in Australia. They are accompanied by a few pearls, which do not call for any praise. A few specimens of copper ores—blue and green carbonates principally—from the Peak Downs district are exhibited. The *pièce de resistance* of the mineral collection is undoubtedly a magnificent piece of malachite from the Peak Downs Copper Mines. Two samples of coal, of good quality, are also shown. A few marbles and building stones complete the display. Amongst the latter two specimens of porphyry occur, one white and one pink, which are apparently of excellent quality.

Up to the present time Queensland appears almost entirely to have devoted her energies to agricultural pursuits, but she must not forget that rich veins of copper ore exist all through the Peak Downs country, and that the success already met with by the Peak Downs Company indicates the existence of copper ore of the finest quality, and in quantities that should stimulate capitalists to subject this district to a more searching examination than it has hitherto received. There seems reason to hope, also, from the geological structure of the country, that coal exists in different parts in large quantities. The banks of the rivers Bremer and Brisbane are rich in coal, and the mines of Messrs. Campbell and Co., of Redbank, have been worked for many years past with great success. In future years, when Queensland begins to spin and weave the splendid cotton she is now growing, she will want all the coal that she can get, and it will be fortunate for her if she can find it at the doors of her own factories, instead of having to rely on her neighbours for her supplies.

South Australia shows many fine specimens of iron, copper, and lead ores, but they are mostly thrown together in the most disorderly manner, and are generally without labels or descriptions of any kind. To judge from the number of specimens shown, the mining industry of South Australia seems to be once more in a comparatively flourishing condition. The enormous success of the Burra Burra Mines when first they were discovered led to the formation of numerous companies whose names are now forgotten, although their deeds, no doubt, live in the memories of their unfortunate victims. In some instances the mines were abandoned, in others the works were merely discontinued for a time. Gradually things were beginning to right themselves, when the discovery of gold-fields in the neighbouring colonies led to the indiscriminate abandonment of all mining operations, with the exception of those carried on at Burra Burra and Kapunda.

The Wheal Coglyn Mining Company show three large blocks of silver lead ore, which is said to be of considerable value, but, in the absence of any analysis, of course we can say nothing.

The Talisker Company are the only other exhibitors of lead ores. They have taken more pains with their exhibition than their companions, giving in most cases the richness of the ore in lead, silver. and gold. One specimen of argentiferous galena yields 85 per cent. of metallic lead, and 59 oz. of silver, and 1 oz. 1 dwt. 16 gr. of gold, to the ton, They also show the ore in different stages of preparation; an ingot of silver lead assaying 74 oz. of silver to the ton; white arsenic, mispickel, a peculiar mundic containing gold, silver, lead, iron, and arsenic; and various other specimens of a similar character. The most abundant mineral production of South Australia is unquestionably copper ore, which occurs in all its varieties. The Moonta Mining Company show some beautiful specimens of native copper, also samples of the yellow, purple, and horseflesh ores, the grey sulphide, the red and black oxides, and the oxychloride. The Moonta Mines are situated at a short distance from the coast in Yorke's Peninsula. They have been comparatively recently opened and are of immense promise. The average richness of the ore is high, most of it realising 30 per cent., and very little falling below 20 per cent. Near the surface the ore is chiefly green carbonate mixed with clay; but at seven or eight fathoms it changes to purple and yellow ore, interspersed with large lumps of metallic copper, many of them weighing several pounds. The first discovery of these rich deposits was in 1861, since which everything that capital and energy could do has been done to render them productive. The Moonta Mines may be looked on as one of the great mining successes of this part of the colony. The Wallaroo Mines show similar products. They also exhibit the clay slate of the country in which the mines are worked, and four photographic views of the works. One of the specimens shown, consisting of grey and red ore mixed with native copper, is extremely rich. The Wallaroo Mines have been so singularly productive since first they were commenced, some seven or eight years since, as to have completely changed the face of the district. Two rapidly rising towns, with a population of 5000 souls, all as busy as bees, now exist where a short time since there was nothing but a solitary sheep

station. One of the most singular characteristics of the country is the utter absence of fresh water. All along the road to Wallaroo (about thirty miles), and for many miles on each side of it, there is no fresh water. The expedient hit upon to overcome this evil was distillation, and, perhaps for the first time in the history of the world, there was a population of some thousands, with all their horses, cattle, sheep, etc., drinking *aqua destillata*. As the building of houses has progressed rain-water tanks have been constructed, and the heavens have become the principal source of the water-supply of Wallaroo.

The Wallaroo Smelting Works show some good specimens of coarse and refined copper, also raw sulphur from the culvert of the roasting kiln, and some specimens of plumbago, full of iron and of very bad quality. The Company also exhibit a model of Captain Hughes's roasting kiln, which merits a close examination.

The Yelta Company and the Spring Creek Company also show yellow, grey, and black ores. It is singular that neither the Burra Burra nor the Kapunda Companies make any sign.

There is a very fine collective exhibition of cabinet specimens of copper minerals from various mines in this locality shown by the Hon. H. Angus, Mr. A. Engelhart, and Mrs. Thomas. They consist principally of magnificent specimens of crystallised green and blue carbonate, red oxide, native copper, and malachite. There are also several specimens classed under the head of "green carbonate," which resemble the Cornwall minerals lately described by Professor Church, Mr. Maskelyne, and others. Some of the specimens of ruby ore are exceedingly fine.

The Murninnie Bismuth and Copper Smelting Company show specimens of fine copper and two ingots of bismuth. The catalogue states that they also show the cupreous bismuth ore from which the metals are extracted, but it must have been lost during the transit, or otherwise mislaid, as it is nowhere to be found. It is said to contain from 5 to 32 per cent. of bismuth, and from 10 to 20 per cent. of copper. It would have been interesting to have known in what state the bismuth exists in the ore, and the process adopted for its extraction. A copper ore containing so large an amount of bismuth is, we believe, as yet unknown in any other part of the world.

The Worthing Company also show ores. The untidy way in which most of the specimens are shown, and the general absence of any numbers by which they can be identified with the names in the catalogue, are great drawbacks to what would otherwise have been a most interesting display. When will exhibitors condescend to study the rudiments of the art of exhibiting?

On visiting New South Wales we experience the same feelings of annoyance and disappointment that we have had so frequently to express during our journey through the minerals of Great Britain and her colonies, relieved, however, in some measure, by those collections which are exhibited as they should be. We allude to the specimens of gold shown by the Exhibition Commissioners (for which they have deservedly received the gold medal). the collection showing the various deposits met with in gold mining, prepared by Lieutenant-Colonel Ward, of the Royal Mint, Sydney, and exhibited by Sir Daniel Cooper, and the collection of rocks illustrating the geology of the New South Wales coal strata shown by Mr. W. Keene. Beyond these we have but little that is exhibited even decently. The same lumps of ore, unnamed, unnumbered, and undescribed, thrown into rough boxes or on to shelves, more, apparently, for the purpose of collecting dust than for any other reason, meet the eye everywhere; the same absence of interesting objects mentioned in the catalogue is observable here as elsewhere, and after searching in vain for specimens that only exist in print the visitor is compelled to close his notebook and give up his search. New South Wales is rich in minerals of all kinds. Gold, silver, copper, iron, lead, and tin, are scattered over the face of the country, but very little capital has yet been applied to the working of these valuable products. There is every reason to believe that the auriferous deposits of this colony are as rich as those of Victoria, but the same skill and enterprise has not yet been applied in working them. A few copper mines are in successful operation, but the vast mass of metallic wealth existing in the country still remains untouched. Coal is plentiful, and already forms an important article of commerce. No less than 20,000 tons per week are raised at Newcastle alone—about sixty miles north of Sydney—and a considerable quantity is produced in the Illawarra district, about forty miles to the south. Kerosene shale has also been discovered in several places, and factories for extracting the oil from it have been successfully established.

The place of honour undoubtedly belongs to the specimens of gold from the various auriferous districts in which alluvial diggings are systematically worked. They consist of some twenty-nine samples, weighing each some thirty ounces, and show the singularly different appearances that gold wears. The specimens from North Armidale, for instance, are small and powdery, while those from West Bathurst are in the form of large nuggets. Those from Hargraves, again, are quite dark in colour, the Stoney Creek and Burrangong samples being of a bright orange. Two large bars of the precious metal, fillets as used in the Sydney Mint, blanks for sovereigns and half sovereigns, and some pieces of quartz with the gold *in sitû*, are also shown. The whole is exhibited by the New South Wales Exhibition Commission.

The collection illustrating the various deposits encountered in sinking for gold, and the character of the gold thus obtained, prepared by Lieutenant-Colonel Ward, of the Royal Sydney Mint, and exhibited by Sir Daniel Cooper, is of the most interesting character. There are thirty-two series of specimens, showing the sequence and thickness of the strata above the wash-dirt containing the gold, terminating with a sample of the bed-rock on which the wash-dirt lies. To each set of specimens, which are arranged in vertical order, a description of the mode of working is appended; the richness of the

wash-dirt is also given, as well as the value of the gold as per assay. We give below a specimen of one of these descriptions, to show the pains and care Colonel Ward has taken with his work:

Burrangong—Tipperary Gully.

No. of stratum.	Thickness of stratum.	
1	4 feet	Fine quartzose sand, with reddish argillaceous cement.
2	8 „	Stiff clay, containing nodules of oxide of iron.
3	7½ „	"Cement," quartzose gravel.
4	10 „	Micaceous clay.
5	12 „	Argillaceous "cement," with mica.
6	9½ „	Whitish clay.
7	5½ „	Argillaceous gravel, with oxide of iron.
8	2 „	Granitic drift, with fragments of quartz.
9	Gold from the above, containing, after melting, in 1000 parts—gold, 947·5; silver, 47·6. Value per oz., £4 0s. 6*d*.	
10	Bed rock, decomposing red granite.	

The shaft whence samples were taken is 38 inches by 22 inches, and 58½ feet deep; average yield of gold, 1½ dwt. to 6 buckets.

The collection of rocks, fossils, and minerals, illustrating the geology of the coal-measures, shown by Mr. W. Keene, F.G.S., the New South Wales Government Examiner of Coal Fields, is of the greatest interest. The specimens are all legibly numbered and described. Numerous samples of excellent coal are exhibited, showing that, as far as appearance goes, New South Wales need yield very little to Northumberland and Durham. The coal from the Borchols Collieries is interesting from its tendency to exhibit a reniform and orbicular fracture, a peculiarity which seems to belong to the middle seams of the series, the upper and lower seams being more disposed to a splintery cleavage. It burns to ash with very little cinder, and is highly esteemed in the Melbourne and Californian markets. The Panama steamers all use Australian coal, as well as the Dutch Steam Navigation Company. By reference to Mr. Keene's series of specimens, it will be seen that eleven distinct seams are already identified, all of which are more or less worked.

In the park, close to the English lighthouse, will be found a specimen of coal from a seam belonging to the Australian Agricultural Company, measuring thirty-two feet in thickness. It is of excellent quality, but its position is too far inland to allow of its being worked properly under present circumstances. Extensive deposits of rich iron ore, with limestone in their neighbourhood, and close to water-carriage, have also been discovered on the property of this company, and it is probable that this particular spot will shortly become the centre of the New South Wales iron industry. We cannot resist saying a word as to the age of the New South Wales coal. From the fossils exhibited, the lower beds of the New South Wales coal-field seem to be older than any worked in Europe, while the upper beds exhibit all the characteristics of the most recent of our true carboniferous formations. From the lowest to the uppermost seams they all appear to have been deposited conformably, and show none of those signs of disturbance or violent eruptions to be seen in European carboniferous formations. In fact, the alternate submergences and elevations of land in this part appear to have been slow and gradual. Turning once more to the catalogue, the unhappy visitor finds mention made of numerous specimens of the greatest possible interest, but after the most diligent search he fails in discovering them. A few, however, that do not exist in print alone may be picked out and described.

There is a fine specimen of grey kerosene shale from Wollongong, shown by Mr. J. Graham. It exists in beds many feet thick, and from its occurrence in many parts of the colony there appears every reason to expect that the deposits are continuous and practically inexhaustible. The shale produces from 60 to 80 gallons of crude oil to the ton.

Brown cannel oil coal from Hartley is also shown by the Western and Hartley Kerosene Companies. This material yields from 100 to 150 gallons per ton.

Some fine specimens of blue, green, and yellow copper ore are shown, but it is impossible to say by whom or from whence, as they are all huddled together on a shelf, like a heap of stones by the side of a road. Amongst them is a good sample of black oxide of copper, which seems to be rather a common mineral in Australia. The catalogue states that various specimens of tin ore are shown, and gives their richness as per assay, but we have failed to discover them.

Mr. Moss shows native alum from Shoalhaven.

Close by, there is a mineral which appears to be magnesite, but all description of its origin or composition is wanting.

Elliot Brothers show superphosphate of lime, bisulphite of soda, and granulated sulphate of iron. These are the only chemical products exhibited.

Some sawdust is shown by Mr. Rudder, which is said to be used as a yellow dye, but no particulars are given as to the name of the tree from which it is obtained.

New Zealand exhibits neither chemicals nor minerals, and Tasmania and West Australia are altogether absent.

In Natal there is but little of interest. There are a few samples of coal from Newcastle, Natal, and Beggarsberg. Mr. J. G. Ross shows some small specimens of iron ore, apparently oligist. Some carbonate of copper and galena are also exhibited, but it is not stated whether the mines yielding them are worked or not. A specimen of indigo from the wild plant seems to indicate the possibility of cultivating this important plant in the colony. There is also a mineral shown which has the outward appearance of hydroboracite (hayesine), but no description is given of it, a long search through the catalogue having proved fruitless.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

End of the Scientific Club at the Palais Royal—Visit of the Duke of Leuchtenberg—Deville's experiments at the Laboratory of the Ecole Normale—Paris Chemical Society—Compounds of silicon—Iodide of iron—Academy of Sciences—Becquerel's experiments on the reduction of metals and formation of crystals by capillary action—Formation of ethers—Death of Civiale and of Trousseau.

PARIS has been too full of kings to remark the departure of *savants* and of Exhibition jurors. The club for foreign chemists and physicists has died of inanition. Some stray visitors, arriving early and finding themselves in the presence of the waiters only, closed the proceedings of the club with monologues less brilliant than the speeches held at the opening dinner some months ago.

Some of the princes now abounding, however, forgetting the words of Archimedes, that there is no royal road to science, visit laboratories and keep up the stir and movement of the last weeks. The Prince of Leuchtenberg, a mineralogist highly celebrated amongst his followers, thus paid a visit to the laboratory of the Ecole Normale the other day. Professor Deville showed to him, and to some chemists invited for the occasion, a few experiments of interest. He fused 500 grm. of iron, and allowed a current of oxygen to pass through the liquid mass, which was thus burnt and thrown about in glowing drops. He formed artificial rubies and artificial apatites, and explained his experiments on the composition of the flame. In these experiments, which consist in filling a tube by aspiration with the gases contained in different parts of the flame, Professor Deville proves that in the hottest part of the flame the combustion is not complete. A little above this part all, or almost all, the oxide of carbon serving as a fuel was found to be converted into carbonic acid; but, there, where the heat is greatest, combination and dissociation, occurring together, prevent the last residue of carbonic oxide being further oxidised.

At the meeting of the CHEMICAL SOCIETY on the 20th ult. M. Friedel made a further communication *on the compounds of silicon* obtained by himself conjointly with M. Ladenburg. They were unable to produce a pure ether by making $SiCl_3HS$ act on alcohol. The sulphur compound thus obtained is transformed by excess of alcohol into sulphuretted hydrogen and silicic ether, $Si(C_2H_5O)_4$. By action of bromine on $SiCl_3HS$, bromide of sulphur and chlorobromide of silicon, $SiCl_3Br$, is obtained. Hydrobromic acid disengaged in this reaction proves again the presence of hydrogen in the compound $SiCl_3HS$. The compound $SiCl_3Br$ boils at 80°. Mercaptan treated with bromine yields, in an analogous manner, bromide of ethyl, hydrobromic acid, and bromide of sulphur. This analogy determines the author to call the compound $SiCl_3HS$ by the name of terchlorinated silicon-mercaptan.

M. Terreil described the production of *crystallised iodide of iron* by making vapours of iodine pass over red-hot iron, an experiment the priority of which the chairman (M. Troost) claimed for M. Caron.

You recollect the curious phenomenon lately described by Becquerel the elder. A solution of nitrate of copper was enclosed in a tube provided with a narrow fissure, and put into a larger vessel containing a solution of sulphide of sodium. Metallic copper was thus produced in the capillary fissure and on the inner surface of the tube.* In a new communication, read before the ACADEMY the 17th ult., the author enlarges upon the subject, and offers an explanation. Metallic gold, silver, lead, cobalt, and nickel, have been produced in the same way; but platinum and chromium could not be obtained in the metallic state. A new apparatus has been devised by the author, consisting of two polished plates of glass, one having a small hole, over which a watch-glass is cemented with mastic. A metallic solution was put into the watch-glass, and the second piece of glass tied to the first, so as to leave the very narrowest capillary space between the two plates. They were then put into the solution of sodium-sulphide. The action was seen to be the more rapid and complete the narrower was the space between the plates. With a solution of gold, coloured rings of metallic gold were produced, and from their colour the distance between the two plates could be estimated. It was found to vary from 98 to 121 millionths of a millimetre. For the reduction of copper the maximum distance permissible was measured by the aid of a micrometer and microscope, and found to be equal to six hundredths of a millimetre. The same phenomena could also be obtained with tubes closed at one end with parchment paper.

Referring to one of his memoirs published in 1833, M. Becquerel explains these reductions in the following way. The two solutions and the liquid contained in the capillary space form a voltaic current without the intervention of any metal, and capable of decomposing metallic salts. By displacing the metallic solution by chloride of calcium, and the sulphide by bicarbonate of sodium, rhombohedral crystals of carbonate of calcium were formed. Silicate of aluminium, chromate of lead, sulphate and carbonate of barium, could also be obtained in the crystalline state, the crystals clinging together in the shape of stalactites of three or four inches in length. These stalactites took the direction of the diffusing liquid, so that they formed in the inner tube or in the surrounding outer tube, according to the solution contained in either.

The author finally calls attention to the important part this sort of capillary chemistry and of capillary voltaism must play in organised bodies composed of capillary vessels, of membranes and tissues containing liquids of different natures. It will be remembered that crystallisations of insoluble salts were obtained by diffusion by M. Fremy in 1866 ('Comptes rendus,' t. lxiii, p. 714), and by M. Macé in 1854.

Another paper *on crystallisation* was communicated at this meeting of the Academy by M. Lecoq de Boisbaudran. Some time ago M. Gerner published the interesting fact that supersaturated solutions crystallise only when touched with a crystal of the dissolved substance. M. Lecoq now inquires into

* See LAB., May 25, p. 134.

the manner in which isomorphous crystals will act on supersaturated solutions. He finds they produce crystallisation, even if their isomorphism be of a limited kind, or, rather, he finds supersaturated solutions of dimorphous substances to crystallise in one system or in the other, according to the nature of the crystal thrown into the solution. Thus, it is well known that the sulphates of cobalt, nickel, iron, copper, zinc, and magnesium, are equally hydrated and isomorphous only under certain conditions of temperature. At 150° they differ, crystallising as follows in three different systems:

(1) $CuSO_4.5H_2O$ doubly oblique.

(2) $\left.\begin{array}{l}FeSO_4.7H_2O\\CoSO_4.7H_2O\end{array}\right\}$ oblique prismatic.

(3) $\left.\begin{array}{l}NiSO_4.7H_2O\\ZnSO_4.7H_2O\\MgSO_4.7H_2O\end{array}\right\}$ right prismatic.

If you add to a supersaturated solution of one of these salts a crystal pertaining to a neighbouring group, the crystals formed will belong to the system of the latter. If afterwards you touch the solution with a crystal of its own kind, a new and more abundant crystallisation will take place, while the crystals formed before become opaque and take the structure of the last-formed crystals. It is thus possible to obtain two or more different crystallisations, each of which destroys the foregoing one.

MM. Reboul and Truchot publish together two interesting observations, one on *the formation of ordinary mixed ethers*, the other on *ethers isomeric with the former*.

The authors were surprised that, according to the observation of MM. Pelouze and Cahours, chloride of hexyl and alcoholic potash should produce hexylene, and not hexyl-ethyl-ether. Repeating the experiment, they were able to prove that the two reactions took place together, and that the expected ether, $\left.\begin{array}{l}C_6H_7\\C_2H_5\end{array}\right\}O$, boiling at 132—134°, was formed, though in small quantities as compared with the quantity of hexylene produced in this reaction.

The chlorides of heptyl, octyl, and decyl, behaved in the same manner; and, on the other hand, the action of chloride of amyl and of bromide of ethyl on alcoholic potash was found to produce, not only mixed ethers, but also small quantities of the corresponding hydrocarbons, amylene and ethylene.

It therefore appeared, as a rule, that for the lower members of the series the formation of mixed ethers prevailed, while for the higher members the formation of hydrocarbons predominated. In submitting to the action of alcoholic potash, not bromide of ethyl, but bromhydrate of amylene, M. Wurtz obtained, not a mixed ether, but amylene. This is one of the characteristics proving the isomerism discovered by M. Wurtz.

MM. Reboul and Truchot have been able, however, to prove that at the same time there was formed a small quantity of a mixed ether, differing from amyl-ethylic ether, and provided by them with the name of ethylate of amylene. It boils at 102° or 103°, while amyl-ethylic ether boils at 112°. Bromhydric acid transforms it into bromide of ethyl and bromhydrate of amylene, recognised by its boiling-point and by the facility with which it yields amylene. This isomerism is, therefore, quite analogous to that discovered by M. Wurtz. It is the natural consequence of the isomerism of alcohols and pseudo-alcohols. The two ethers are expressed by the discoverers by the formulæ—

$$\left.\begin{array}{l}C_5H_{11}\\C_2H_5\end{array}\right\}O \quad\text{and}\quad C_5H_{10}\left\{\begin{array}{l}H\\C_2H_5O.\end{array}\right.$$

Amyl-ethylic ether. Ethylate of amylene.

Their observations can most likely be extended to the other members of the series.

Experiments on the formation of ethers were likewise offered at this meeting by MM. Girard and Chapoteaut. It has been known for some length of time that chloride of tin ($SnCl_4$) combines with alcohol, and on heating forms ether and chloride of ethyl. By adding two equivalents of alcohol the compound analysed by Lewy in 1839, $(C_2H_6O)_2SnCl_4$, was formed. By adding water, after heating it to 100°, ether and chlorhydric ether are formed. By heating it with ethylic, methylic, and amylic alcohols, it forms mixed ethers. If alcohol is mixed with an equivalent of acid, and if chloride of tin is then slowly added, compound ethers are formed, according to the formula—

$$(C_2H_6O)_2SnCl_4 + 2C_2H_4O_2 = \left.\begin{array}{l}2C_2H_5\\C_2H_3O\end{array}\right\}O + SnO + 2HCl + H\,O.$$

Benzoic ether has thus been obtained in almost theoretical quantities. Formic, acetic, butyric, palmitic, stearic, lactic, and tartaric ethers have been produced in the same way.

Dr. Crace Calvert publishes an interesting note on *oxidation by oxygen condensed in charcoal*. He introduced a small tube of hot charcoal into a measured volume of oxygen. After twenty-four hours, when absorption was complete, he introduced another gas, or some drops of a liquid, into the oxygen, and he thus obtained the following oxidations:

(1) Sulphuric anhydride with sulphurous anhydride.
(2) Sulphuric acid with sulphuretted hydrogen.
(3) Phosphoric acid with phosphoretted hydrogen.
(4) With alcohols the corresponding acids; and
(5) With ethylene, propylene, and amylene, water and carbonic acid.

Sometimes (as in the case of sulphuretted hydrogen, for instance) the absorption indicated by the rising mercury corresponded to more than the volume of the gas to be oxidised or of the compound produced by oxidation. It became, therefore, evident that a fresh quantity of the remaining oxygen had been absorbed by the charcoal.

The third and last place added to the section for navigation and geography has been filled up at this meeting by the election of M. Villarceau.

The death of a member of the section for medicine, M. Civiale, was announced to the Academy; and but a few days later the school of medicine lost another

celebrated professor, M. Trousseau, who died after many months' illness. [Up to the time of going to press our correspondent's report on the more recent proceedings of the Paris Societies had not been received.]

ORIGINAL COMMUNICATIONS.

M. SALET ON AFFINITY AND ELECTRICITY.

Affinity and Electricity. By GEORGES SALET.

"The forces called Electricity and Chemical Affinity are one and the same."—FARADAY.

1. When an electric current passes through a compound liquid, that liquid is decomposed, certain of its elements being transferred to one electrode, the rest to the other. We cannot regulate this partition at pleasure; but we know that in all possible cases the quantities of matter eliminated at the two electrodes are chemically equivalent one to the other. This does not imply that these quantities are proportional to the so-called equivalents, unless we mean to denote by that word quantities of matter which exhibit the same atomicity (quantivalence).

When several electrolytes are traversed by the same current, Faraday's law still holds good, equivalent quantities of matter being liberated at each electrode. If, for example, chlorhydric acid, sulphuric acid, and ammonia, are simultaneously electrolysed, the quantities of these bodies decomposed will be to one another as—

$$H \,;\, Cl \qquad \tfrac{1}{2}(H_2 \,;\, SO_4) \qquad \tfrac{1}{3}(H_3 \,;\, N);$$

consequently,

$$H', \; Cl', \qquad \tfrac{1}{2}(SO_4)'' \quad \text{and} \quad \tfrac{1}{3}N'''$$

are equivalent.

When a number of chlorides are simultaneously decomposed, the current ought to eliminate equal quantities of chlorine in all the decomposing cells: for, as chlorine is univalent, one atom of chlorine can only be equivalent to another single atom of the same element. With polyatomic (multivalent) bodies, however, the case is different; thus, $(Cu_2)''$ may be equivalent to Cu'': hence it follows that the electrolysis of cupric, cuprous, and antimonious chlorides ought to take place—and, in fact, does take place—as follows:

$$\tfrac{1}{2}(Cu \,;\, Cl_2) \quad \tfrac{1}{2}(Cu_2 \,;\, Cl_2) \quad \tfrac{1}{3}(Sb \,;\, Cl_3).$$

That which has been said respecting univalent chlorine and bivalent copper applies equally well to univalent hydrogen and bivalent oxygen; the electrolysis of water and of oxygenated water ought, therefore, to take place, and does, in fact, take place, thus:

$$\tfrac{1}{2}(H_2 \,;\, O) \qquad \tfrac{1}{2}(H_2 \,;\, O_2).$$

There is no known exception to this law when expressed according to the principles of modern chemistry.

2. If, with the current produced in a battery by the solution of an equivalent of iron in chlorhydric acid, an equivalent of hydrogen could be liberated, according to Faraday's law, in each of a series of voltameters of indefinite length, a quantity of gas would soon be collected sufficient to evaporate, by the heat of its combustion, the chloride of iron formed in the battery; reduce this chloride of iron; and thus reconstitute the system of iron, acid, and water; and there would, moreover, be a gain of the quantity of heat due to the surplus of hydrogen. Now, this creation of working force (*vis viva*) is mechanically impossible, and accordingly we find that the current refuses to pass through the electrolyte. The reason of this is that each voltameter in activity is the seat of an electromotive force which is opposite in direction to that of the battery, and, in case of equality, annihilates the current. How should this inverse electro-motive force be regarded at the present day? A comparison will serve to place the matter in its true light.

When carbon is burned in the furnace of a steam-engine, it satisfies its affinity for oxygen and yields a compound which cannot be decomposed, except by the use of very powerful means, as, for example, by communicating to it a considerable quantity of working force in the shape of heat. When the compound is thus destroyed, the carbon and oxygen are regenerated, and again become capable of burning together; with their separation they may be said to have regained their reciprocal affinity. In short, if affinity be defined as the power possessed by bodies of uniting together, this affinity will vanish with the liberation of the working force which accompanies combination, and reappear when working force is again expended to destroy the combination. There is, indeed, nothing to prevent us from regarding affinity as a peculiar manifestation of working force, capable of being transformed into heat or electricity according to circumstances.

The working force derived from the carbon and oxygen is communicated in the boiler to the steam, which gives up a portion of it to the mechanical organism which it animates; and this working force shows itself in the form of motion available for industry.

Suppose, now, that the immediate office of our steam-engine is to raise water in a vertical mass. Its duty or energy will be measured by the height of the column and the mass of water raised; and as the engine will be more powerful in proportion as either of these magnitudes becomes greater, its energy may be represented by their product, $m \times h$.

If, now, the fall of the water thus raised be utilised for doing mechanical work, this work, proportional to the same product, will be equivalent to the amount of working force which has been derived in the form of heat from the combustion of the coal, and has disappeared as such in the machine. Suppose, now, that we try to get from this fall of water a greater amount of work than it is capable of yielding—that a water-wheel, for example, placed in its course, is required to raise a weight which equilibrates (or more than equilibrates) the column of water which is the source of the power; under these circumstances the wheel will not raise the weight, and if the weight were raised for an instant, it would tend to make the water rise again into the reservoir. Now, as the supposed engine cannot raise the water to a higher level than this, it will stop, and the steam will escape by the safety-valve without producing any useful effect.

In the battery also, affinity is the source of the energy distributed by the current through the various organs which it animates; and just as this energy is represented, in the case of the steam-engine, by the product $m \times h$, so may the energy of the battery be measured by the analogous product $q \times f$, in which q is the quantity of electricity and f the electro-motive force.

Quantity of electricity is the element which depends directly on Faraday's law. An equivalent of zinc develops, by its solution in the battery, a quantity of electricity $= 1$; and the electrolysis of an equivalent of chlorhydric acid, or of an equivalent (half-molecule) of water, requires also a quantity of electricity $= 1$. This quantity corresponds exactly to the quantity of water elevated by the steam-engine above mentioned.

The electro-motive force corresponds, in the same mode of comparison, to the height to which the water is raised, and this comparison may be carried even further. With two elevating machines, each capable of raising 1 kilogramme of water to the height of one metre, we may, by disposing them in different ways, raise either 2 kilogrammes of water 1 metre, or 1 kilogramme of water 2 metres high, the water being drawn in the one case by the two engines from the same well, and the reservoir of the one serving in the other case as the well of the second engine.

Suppose, now, two batteries to be connected by their opposite poles. The solution of an equivalent of zinc in each of them will generate a quantity of electricity equal to 1, but the tension or electro-motive force will be doubled. If, on the contrary, they are connected by their similar poles, the solution of the same quantity of zinc in each will generate altogether a quantity of electricity $= 2$, but the electro-motive force will be merely that of each battery acting alone. This last example shows that the electro-motive force does not vary with the dimensions of the plates of the battery. This force is, however, intimately related to the chemical activity of the reacting substances.

When the poles of a battery are connected by a wire, this wire becomes heated, and the heat is proportional to the product $q \times f$, since it is the sole manifestation of energy by the battery. If an electro-magnetic machine be interposed in the circuit, a certain quantity of heat ceases to be developed, its equivalent appearing in the machine as mechanical work.

The quantity of working force abstracted from a fall of water by a machine which it sets in motion, is proportional to the height of the fall thus utilised. The quantity of working force abstracted by an electro-magnetic machine from an electric current is proportional to the corresponding diminution in the element which we have compared to heat, that is to say, the electro-motive force. To diminish the electro-motive force f by the quantity f', comes to the same thing as creating an inverse electro-motive force $= f'$.

Suppose a voltameter to be interposed in the circuit. We thereby compel the electricity to act chemically. The chemical work of destroying an equivalent of a compound body ought to be completed while an equivalent of zinc is being dissolved in the battery—that is Faraday's law. But there is nothing to prove that the decomposition is possible under the given circumstances. If the energy of the battery $= 1 \times f$ is less than the amount of working force demanded by this work, it is clear that the current cannot pass. It is as if the fall of water were required to exert an amount of power greater than that which has been developed in it by the elevating force. If, on the other hand, the work of decomposing an equivalent of a compound body absorbs only a quantity of working force $= 1 \times f'$ (where f' is less than f), the current will pass; but the quantity of available electro-motive force remaining in the current will be only $f - f'$, just as if an inverse electro-motive force f' had been added. In this case, if the decomposed bodies remain in the decomposing cell, and the electrodes are connected by a wire, an inverse current, having an electro-motive force equal to f', will actually be developed.

The relation expressed by Faraday's law is therefore an obstacle to the decomposition of bodies which require for their decomposition a considerable amount of energy: for the decomposition of an equivalent of these bodies

necessarily requires a quantity of electricity equal to 1, and a battery capable of affording this quantity does not always possess the tension or electro-motive force necessary to ensure that f' shall be less than f. But the difficulty can always be overcome by connecting the batteries by their opposite poles, by which means we gain in electro-motive force as much as we lose in quantity—just as if, in order to overcome the resistance of a machine placed in the course of a fall of water, the yield of water in a given time were diminished for the sake of increasing the height of the fall.

3. The product of the quantity of electricity into the electro-motive force not only represents the energy of the battery, but measures also the work of the affinity of which that energy is the transformation.

If the reaction be referred to the unit of atomicity, or—which comes to the same thing —the energy of the battery be referred to the quantity 1 ($q = 1$), it will be seen that the heat developed by a reaction is proportional to the electro-motive force of the battery due to this reaction: for Favre and Silbermann have shown that the heat developed within the battery and in the circuit is independent of the nature of the latter, and equal to $q \times f$.

It appears, then, that either calorimetry or electro-motive force will serve equally well to measure the work of affinity in any reaction, and that the term tension, or electro-motive force, in electricity, is equivalent to the term chemical activity or affinity, just as the term quantity of electricity corresponds to the chemical notion of atomicity.

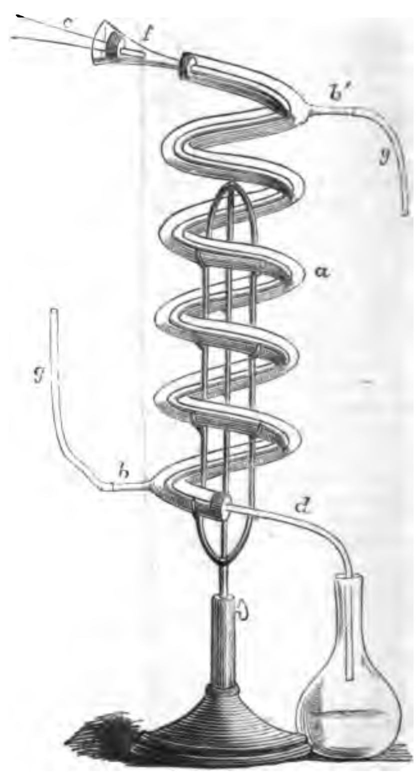
MR. BARFF ON NEW CHEMICAL APPARATUS.

Description of a Spiral Condenser in Glass for Distillation, and of an improved Syphon. By F. S. BARFF, *M.A.* (*Cantab.*), *F.C.S.*

THE inconvenience experienced from the size of a Liebig's condenser when great length of cooling surface is required, and the necessity which often arises of having to unite two condensers when the vapour to be liquefied requires considerable cold for its condensation, seemed to render it desirable to get, if possible, a more compact apparatus acting on the same principle. The objection to using a spiral condenser has hitherto been that it had to be enclosed in a vessel containing a large quantity of water, and the effect of a constant small stream around the condensing tube could not be obtained. Several attempts have been made to form a spiral condenser on Liebig's principle, and I have occasionally produced such an instrument by simply passing a piece of elastic tubing over a glass spiral tube of smaller diameter. This contrivance, however, is only a makeshift, and is not convenient, though, if the ends of the elastic tube be well secured so as to hold water, and if short pieces of glass pipe be inserted at both ends for the admission and discharge of water, it will answer the purpose, but it is always liable to get out of order.

The most desirable method of forming an efficient spiral condenser seemed to be to bend two glass tubes together in such a way that the inner tube should be, in every part, perfectly free from the outer, so as to allow a small continuous current of water to pass between them. After several experiments I found the best method of effecting this was to take two tubes of the required size, fixing the smaller by means of wedges in the centre of the larger, and filling both with perfectly dry whiting. The whiting should be dried at a temperature a little below red heat, and should

Fig. 1.



be used before it has absorbed moisture, as the

presence of the least moisture is certain to cause the breakage of one or both of the tubes. Both tubes can then be bent together by the aid of a glass-blower's lamp, such as is used in most laboratories, a large and powerful flame being requisite. Of course, the operation is one of some difficulty, and requires great skill in manipulation.

The condenser which is represented in Fig. 1 was made for me by Mr. Cetti, of Holborn, and I have no doubt that any other glass-blower would be able to make one equally well. There is no difficulty in softening the glass, if sufficient heat be used, but it requires a practised hand to get the curves regular. I do not imagine that the price would be in any way prohibitory, as I feel sure that the condensers could be made for seven or eight shillings each, though that which I am about to notice cost ten shillings. Before describing the condenser, it may be well to remark that it can be placed in a vessel of ice; the vessel should be made of metal, with a hole through which the pipe *d* can pass, a piece of india-rubber tubing being passed over it to make the hole water-tight.

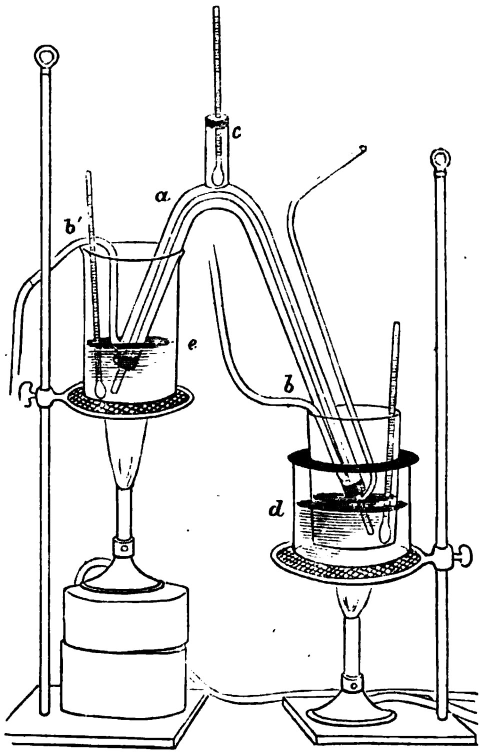
In Fig. 1 *a* is the double spiral *b*, *b'*, the connecting glass tube fixed into the outer spiral about three inches long, for fastening the elastic tubes *g*, *g*; *b* is for the admission of the condensing water, and *b'* for its exit; *c* is the neck of the retort; *f*, an adapter worked on the end of the inner spiral, and *d* the exit for the distillate.

The supporting frame consists of three iron wires (the section of which forms a triangle) touching the spiral internally, and at the points where they touch fastenings are attached, which half encircle the glass tube. The three wires are joined together above and below, and are united to a rod which moves up and down in the tube of the stand, so that the condenser can be raised or lowered at pleasure.

The height of the spiral is less than seven inches, and its diameter three inches and a half; the surface which can be cooled is three feet long. Ordinary Liebig's condensers do not usually exceed two feet or two feet six inches. A great advantage in this form of condenser is that two or three, if required, can be joined together and will occupy but little space. I am contriving an apparatus for fractional distillation in which a series of these condensers will be used, and so arranged that each will condense at a fixed temperature. I will give a full description of this apparatus when it is completed.

Although the spiral is, perhaps, beyond the manufacturing powers of most amateurs, there are some other applications of this method of bending tube within tube which may be found useful. For ascertaining the solubility of salts at different temperatures a syphon, jacketted with a glass tube, allowing a current of water to play round it at any given temperature, can be made, so that a liquid can be conveyed from one vessel to another without experiencing any change of temperature, and

Fig. 2.



the quantity of a salt dissolved at that temperature can be determined from a measured quantity drawn off by the syphon.

This arrangement is shown in Fig. 2; *a* is the syphon, *b*, *b'* glass tubes to which india-rubber tubing can be attached for the water at a given temperature to pass through the jacket, *b* being for ingress and *b'* for egress. *c* is a short tube fixed into the jacket for a thermometer, which should be passed through a cork and so fixed in it; *d* is a beaker with a metal ring supporting a graduated glass, into which the liquid is to be syphoned off from *e*.

LONDON WATER.

Some Pumps and Springs in and about London, examined by J. A. Wanklyn, E. T. Chapman, *and* M. H. Smith.

Date when taken. 1867. June.	Name of Source.	Parts in 1,000,000. I. Ammonia as such.	II. Ammonia from Urea.	III. Ammonia from Albuminoid matter.	IV. White of Egg.
22	(1) Wimbledon Water (Wolsey's Well)	0·03	...	0·16	5·70
27	(2) Buckhill Spring, Kensington Gardens	0·03	...	0·15	5·35
21	(3) Great St. Helen's Pump	3·75	...	0·18	6·43
27	(4) Pump in Bartholomew's Lane, east end of the Bank	5·00	0·50	0·24	8·57
28	(5) Pump in Bishopsgate St., opposite Houndsditch	7·50	...	0·255	9·09
28	(6) Pump in St. Paul's Churchyard	0·06	...	0·135	4·82
29	(7) Pump in Cornhill, south side of the Exchange	9·00	...	0·195	6·96
29	(8) Pump in Drapers' Hall	6·00	1·00	0·315	11·24
*30	(9) Water from Pump, Plantation Place, Starch Green, W.	0·60	0·30	0·18	6·43
*30	(10) Pump, Brentford Lane, Acton, about 100 yards from the Red Lion Inn	0·24	Distinct trace.	0·045	1·61
July. 1	(11) Water from Well in Berkeley Square	0·60	...	0·005	0·18
1	(12) Pump in Fenchurch Street, corner of Church Row	3·30	...	0·15	5·35

* All the waters except the two marked * were examined on the day they were taken. The two marked * were examined the day after.

In the foregoing table are given the results of examinations of twelve waters. The table is calculated on the million parts, 1 in 1,000,000 being one milligramme in a kilogramme or litre of water.

Column I contains the ammonia existing as such in the original water.

Column II gives the ammonia got from urea present in the water.

Column III gives the ammonia got from the albuminoid matters.

Column IV is calculated from Column III. 2·80 parts of ammonia give, according to our determination, 100 parts of white of egg. This column is introduced to give an idea of the amount of organic tissue to which the ammonia would correspond.

These examinations of waters were made according to the method described at the Chemical Society on June 20th.*

Most of the waters mentioned in the table are decidedly unfit to drink. No 1 and No. 2 contain a sufficiently small quantity of ammonia, but then they are too highly charged with albuminoid matter. They are, however, not worse than the average supply to London. The pump in St. Paul's, No. 6, strange to say, is almost equal to the best water supplied to London. No. 10 is by nature an excellent water, but is damaged by the natives, who have converted the enclosure in which the pump stands into a urinal. No doubt a certain amount of infiltration takes place, and this accounts for the small but distinct sign of urea which we obtained.

Water No. 9 appears to be by nature good, but suffers lamentably from the same cause, there being in this instance a hole within the enclosure which apparently communicates with the well. The water enjoys a high local reputation.

No. 11, the pump in Berkeley Square, is excellent as far as albuminoid matter goes, but the large amount of free ammonia is a suspicious circumstance, and suggests infiltration.

The pump in Drapers' Hall is a horror—ammonia, urea, albuminoid matter, all in terrible quantity. The pump in Cornhill carries the palm in point of ammoniacal badness. The pump in Bishopsgate Street (No. 5) and the pump in Bartholomew Lane (No. 4) are very bad, and both of them enjoy high local reputations.

The Great St. Helen's pump and the pump in Fenchurch Street are much used for drinking purposes, and are certainly cool and sparkling. They ought, in common with most of our list, to be closed.

* See Lab., June 29, p. 241.

We have to add in conclusion that every sample was taken with our own hands, and that the examination was made soon after collection —a fact of some importance, inasmuch as the ammonia diminishes on keeping.

EDITORIAL NOTES.

THE PRIZE ROLL OF THE PARIS EXHIBITION.

THE International Jury has awarded 64 grand prizes, 883 gold medals, 3653 silver medals, 6565 bronze medals, and 5801 honourablé mentions.

In Class 44 (chemical products) the gold medals have been distributed as follows:

France 27, Great Britain 7, Belgium 1, Austria 6, Holland 1, Wurtemburg 3, Hesse 1, Prussia 5, Italy 1, Bavaria 1.

It will be seen from this list that, after France, who, of course, would gain most prizes at her own exhibition, Great Britain stands at the head of the competing countries in chemical manufactures, in spite of the deplorable fact that her chemical industry is not even decently represented,

Our special correspondent has obtained from the Imperial Commission the following list of awards to British Exhibitors in the Class which he has so minutely described in these pages.

CLASS XLIV.

Hors concours.

Allen and Hanbury (Hanbury, *juror*).
Chance Brothers.

(*No Grand Prix was awarded in Class* 44.)

Gold Medals.

Allhusen and Sons	Alkalies, etc.
Gossage and Sons	Improvements in soda manufacture.
Muspratt and Sons.........	Alkalies, etc.
Jarrow Chem. Co.	Alkalies, etc.
Howards and Sons.........	Salts of quinine.
Price's P. Cand. Co.	Candles, glycerine, soap.
Young, J.	Paraffin candles.

Silver Medals.

Gaskell, Deacon, and Co.	Alkalies, etc.
Walker Alkali Co.	Alkalies, etc.
Macfarlane and Co.	Salts of morphine.
Morson and Sons	Alkaloïds, etc.
Smith and Co., T. and H.	Morphine preps.
Johnson and Matthey ...	Chemicals.
Field, J. C. and J.	Candles.
Denton and Jutsum	Varnishes.
Mander Bros.	Varnishes.
Demuth and Co.............	Coal-tar products.
Warne and Co.	India-rubber.
Parkes, A.	Parkesine.

Silver Medals—(continued).

Rose, A. W..................	Oils and grease.
Bewicke and Vincent	Varnish.
Crace Calvert and Co......	Carbolic acid.
Tudor, S. and W.	White lead.
Knight and Sons...........	Soap.
British Seaweed Co.	Iodine process.
Gibbs, D. and W............	Soaps.
Bailey, J.	Colours for porcelain.
Cow, Hill, and Co.	India-rubber.
Hopkin and Williams......	Fine chemicals.
Condy, H. B.	Disinfectants.
Howlet and Campsie Alum Co.	Alum and prussiates.
Cook, W., and Co.	Soaps.
Ogleby and Co.	Candles.

Bronze Medals.

May and Baker	Mercurials.
Hodgson and Simpson ...	Soap.
Taylor, W., and Co.	Candles.
Day and Martin	Blacking.
Garrod and Co.	Varnish.
Mackay	Varnish.
Lowe and Co.	Carbolic acid.
Turner and Sons	Varnish.
Dodge	India-rubber.
Britannia Rubber Co. ...	India-rubber.
Pulford	Magenta paints.
Stephens	Wood stains.
Parker and Co.	White lead.
Langton and Bicknells ...	Spermaceti.
Haas and Co.	Indigo.
McDougall Bros.	Disinfectants.
Cook and Co.	Alkalies, etc.
Burgoyne, Burbridge, and Squire.	Pharm. preps.
Davy, Yates, and Routledge.	Chemicals.
Squire, P.	Pharm. preps.
Darney.......................	Glue.
Windle........................	Machinery oil.
Goodwin	Varnish.
Hosegood.....................	Colours.
Lambe and Sterry	Paraffin candles.
Clarke	Night-lights.
Calley	Iron paints.
Rogers........................	Mineral oils.
Nimmo	Glue.
Huskisson	Iodides, etc.
Holland	Pharm. preps.
Bush	Essential oils.
Ransom	Pharm. preps.
Talbot and Alder	Colours.
Green	Gelatine.
Adams	Plate powder.
Rumsey	Plate powder.
Sharon Chem. Co.	Chemicals.

We shall publish a list of the awards to British Exhibitors in Class 40 next week. We may mention, however, that one of the gold medals has been awarded to Johnson and

Matthey for precious metals. The same firm has also gained a medal in Class 47 for platinum vessels. The Patent Plumbago Crucible Company has received a silver medal, and the Silicated Carbon Filter Company a bronze one.

The winners of the grand prizes who represent chemistry and metallurgy are named below:

Grands Prix.

Jacobi, St. Petersburg ...	Application of galvanoplastic to the Arts.
Secchi, Rome	Meteorograph and meteorological and astronomical works.
Krupp, Essen, Prussia ...	Cast steel.
Petin and Gaudet, Rive-de-Gier, France.	Cast steel and iron.
Schneider and Co., Le Creuzot, France.	Iron manufactures.
Bessemer, London	Manufacture of steel.
Hofmann, Berlin	Discovery of aniline colours.
Siemens, London	Regenerating gas furnace.
Hirn, Logelbach, France	Telegraph cables.
Field, Cyrus, and the Anglo-American Companies.	Atlantic telegraph.
Penn and Son, Greenwich	Steam engines.

The following commissioners, exhibitors, and jurors, have been promoted to higher rank, or nominated chevaliers in the Legion of Honour:

Legion of Honour.

Grand Officer:

Le Play, General Commissioner of the Exhibition.

Commanders:

Béguyer de Chancourtois, Chief Engineer of Mines, Secretary to the Imperial Commission.

Kuhlmann, manufacturer of chemical products at Lille.

Baron Liebig, Bavaria.

Officers:

Fourcade, manufacturer of chemical products at Paris.

Sterry Hunt, Canada.

Sir William Logan, Canada.

Father Secchi, Director of Observatory, Rome.

Krupp, manufacturer of steel, Prussia.

Hofmann, professor at the University of Berlin.

Dove, professor at the University of Berlin.

Chevaliers:

Grandeau, Doctor of Sciences.

Schrötter, Vienna.

Fehling, President of Class 44.

Danielsen, Sweden.

Caselli, Italy, inventor of the autographic telegraph.

DEFINITE CONSTITUTION OF THE FIRE-CLAYS.

A REMARKABLE paper on the minerals Kaolinite and Pholerite, by Johnson and Blake, of New Haven, in the May number of 'Silliman's American Journal of Science,' merits the attention of chemists and manufacturers, as well as of the mineralogists to whom it is directly addressed.

Under the names Nacrite, Pholerite, and Steinmark, many different observers have described tabular crystals of rhombic form, compacted, for the most part, into plates and bundles, and usually of microscopic size. The researches of Johnson and Blake now show, first, that all these minerals are referable, with few exceptions, to one and the same species, for which they propose the name kaolinite; and, secondly, that the common clays—or, at the least, their purer varieties—are little more than aggregations of crystals of the mineral in question.

Johnson and Blake have examined with the microscope some twenty different specimens of pipeclay, kaolin, and fire-clay. In all of these samples they have found a larger or smaller proportion of transparent plates of crystalline kaolinite, and in most of the specimens the plates make up the great bulk of the substance. The behaviour of a finely divided white kaolin from Diendorf (Bodenmais), Bavaria, may be taken as typical of that of all the finer plastic clays. When dusted dry upon a glass slide of the microscope, it appears to consist chiefly of masses of a white substance, which are opaque, or nearly opaque, by transmitted light; but when fully illuminated above and below have the translucent aspect of snow in the lump. Interspersed among these masses may be seen extremely minute transparent plates of irregular rounded outline. When brought into water the masses are almost entirely resolved into similar transparent plates, most of which are not more than 0·0001 of an inch in breadth. Even the dark-coloured Stourbridge clay is made up in large part of transparent laminæ, and the same remark is true of various blue fire-clays and of other clays, both white and coloured. In several samples of kaolin prismatic bundles of loosely aggregated plates were observed. These bundles are usually curved, irregular, and three or four times as long as broad. In one instance the bundles contained hexagonal plates, which could be made out with ease under a quarter-inch objective. Other specimens, when rubbed between the fingers, assumed a distinctly pearly lustre, and, after this treatment, by which the prismatic crystals were broken up, microscopic examination revealed an abundance of hexagonal plates.

Even powdery, pulverulent varieties of kaolin were found to consist of definite hexagonal tables, averaging 0·0005 of an inch in diameter, usually thin, but sometimes aggregated into short prisms.

Kaolinite is a soft, white, transparent, infusible mineral, crystallising in forms which probably belong to the trimetric system. Its specific gravity is 2·6. When crystallised it has usually a pearly lustre; it is insoluble in dilute hydrochloric acid, and in most of its forms is difficultly decomposed by hot concentrated hydrochloric acid; hot oil of vitriol decom-

poses it, and it dissolves completely in strong solution of the caustic alkalies. Its composition may be represented by the formula—

$$Al_2O_3,\ 2SiO_2 + 2H_2O.$$

The foregoing facts will afford the basis of a more satisfactory explanation of the plasticity of clay than it has been possible to frame hitherto. Upon this point, however, Messrs. Johnson and Blake do not as yet commit themselves absolutely to any special theory; they only urge that the plasticity of clay is a physical character, apparently closely connected with the fineness of the particles. Pure kaolinite, from Summit Hill, Pennsylvania, consisting chiefly of crystal-plates averaging 0·003 of an inch in diameter, is destitute of plasticity. A nearly pure variety of the mineral from Richmond, Virginia, which occurs in bundles of much smaller dimensions, the largest being but 0·001 of an inch in diameter, is still scarcely plastic. Other varieties of the coarsely crystallised mineral illustrate the same truth, though when rubbed between the fingers they become soapy to the feel. The more finely divided fire-clays, however, together with porcelain earth and other clays, in which there are no bundles or aggregations of crystals, and in which the plates themselves are extremely small, are all highly plastic. So, too, the crystals of kaolinite from Summit Hill, when triturated in an agate mortar, yield a powder which exhales the argillaceous odour when breathed upon, and becomes highly plastic and sticky on being moistened with water; under the microscope the powder closely resembles the finer varieties of kaolin. This experiment accords with the experience of those chemical manufactures—to say nothing of the potters—who, when using china clay as a lute, take pains to have the paste thoroughly kneaded beforehand in order that it may adhere more strongly to the glass. Certain analyses of kaolin from Passan, published by Sommaruga, in 1865 ('Chem. Centralblatt,' p. 268), evidently bear upon the same point, for they show that the chemical composition of two varieties of kaolin used in the Imperial Porcelain Works at Vienna, one of which is "short" and the other "fat," is almost absolutely identical.

It may well be that the plasticity of a clay is related to the form of the plates of kaolinite contained in it, and, perhaps, to their thickness; but upon this subject it is admitted that further investigation is required. The observations of Johnson and Blake indicate that the impurer sedimentary clays are the most plastic; and since some of these clays are not so fine as "shorter" kaolins, it may be true that their plasticity is in part due to the impurities contained in them.

Remarkably enough, the formula of kaolinite deduced from analyses of the pure mineral, as found crystallised in coal seams and elsewhere, does not differ from the formula proposed long ago for kaolin by Forchhammer as the result of his extended investigation of the chemical composition of clays. In this respect the experiments of Johnson and Blake merely corroborate those of the Danish chemist. It is more particularly in their investigation of the physical constitution of the clays that the American observers have done good service by the discovery of the important facts above enumerated. Their work enforces the old lesson, that good harvests are still to be won from many a well-worn field now lying fallow, and commonly thought to be exhausted and sterile.

UNIVERSITY OF LONDON.

THE examination papers in Natural Philosophy and Chemistry have been placed in our hands by one of the candidates for matriculation, and as they will interest many of our readers we print them below. It is our intention to publish as soon as possible after each of the London University examinations the papers in these two subjects.

MATRICULATION EXAMINATION.—JUNE, 1867.

Friday, June 28.—Morning, 10 to 1.

NATURAL PHILOSOPHY.

Examiners:—Prof. R. B. Clifton, M.A., and Prof. G. G. Stokes, D.C.L., F.R.S.

1. Three strings are tied in a knot; the ends of two of them are fastened to pegs, and the third has a known weight attached to it. Give a construction for finding the forces pulling the pegs, and from the construction show to what these two forces respectively become almost equal when one of the supporting strings is almost long enough to allow the other to hang in a vertical position.

2. Sketch a system of pulleys, one fixed and two movable, in which one end of the string passing round each pulley is attached to the weight, and find the relation of the power to the weight in equilibrium.

3. A cylinder is placed on one of its ends on a horizontal plane, sufficiently rough to prevent sliding, and is gradually pulled by a string attached to its upper end, until it falls over. What part of the upper surface is just over the point of contact of the base with the plane when this takes place?

4. A stone, after falling for one second, strikes a pane of glass, in breaking through which it loses half its velocity. How far will it fall in the next second?

5. At what depth in a lake is the pressure of the water, including the atmospheric pressure, three times as great as at the depth of ten feet, on a day when the height of the liquid column in a water-barometer is 33 feet 6 inches?

6. A lump of bees'-wax, weighing 2895 grains, is stuck on to a crystal of quartz weighing 795 grains, and the whole, when suspended in water, is found to weigh 390 grains. Find the specific gravity of bees'-wax, that of quartz being 2·65.

7. A barometric tube of half an inch internal diameter is filled in the usual way, and the mercury is found to stand at the height of 30 inches. A cubic inch of air having been allowed to pass into the vacuum above the mercury, the column is found to be depressed 5 inches. What was the volume of the original vacuum?

8. If an organ-pipe were filled with, and blown with, coal-gas instead of air, what effect, if any, would be produced on the pitch of the note?

If the pipe, filled with air, were blown with coal-gas, which gradually displaced the air in the pipe, what would be the effect?

9. A ray of light AB is at B partly reflected in the given direction BC, and partly refracted. What must be the direction of the reflecting surface at B, and in what plane must the refracted ray lie?

Friday, June 28.—Afternoon, 2 to 5.

CHEMISTRY.

Examiners:—Henry Debus, Esq., Ph.D., F.R.S., and Prof. Williamson, Ph.D., F.R.S.

1. Describe and explain the preparation of oxygen from potassic chlorate (chlorate of potash); and name the substances which are formed when carbon, hydrogen, sulphur, and phosphorus, are respectively burned in an excess of oxygen. Which of the following bodies can be burned in oxygen:—Sulphur, nitrogen, coke, sulphurous acid, wax, iodine, chlorine, and ammonia?

2. What weight of oil of vitriol (H_2SO_4) must be decomposed for the evolution of one gramme of hydrogen?

3. Give the symbols of the following elements and compounds:—Hydrogen, nitrogen, nitrous oxide, carbon, marsh-gas, chlorine, bromine, phosphorus, phosphoric acid, and silicic acid.

4. Describe the effects produced by chlorine on the following substances:—Indigo solution, copper foil, powdered antimony, powdered charcoal, phosphorus, and sulphur.

5. How much carbon could be completely burned by a ton of air?

6. Explain, by means of symbols, the preparation of hydrochloric acid from common salt and sulphuric acid. How many volumes of chlorine and hydrogen are required for the preparation of two volumes of hydrochloric acid? How does water act on hydrochloric acid gas?

7. What degree of the Centigrade scale corresponds to 85° F., and what degree of the Fahrenheit scale to —40° C.?

8. Name the most important natural substances in which nitrogen is contained; and describe how you would prepare nitrogen. Enumerate the principal properties of nitrogen; and show how it may be distinguished from oxygen, hydrogen, and carbonic acid.

CORRESPONDENCE.

CALCULUS OF CHEMICAL OPERATIONS.

To the Editor of THE LABORATORY.

SIR,—Though I acknowledge the kindness of Sir B. Brodie in replying to my former letter concerning his chemical calculus, I must say that his answer is an enigma to me. He blames me for applying to his fundamental equations the simplest algebraic process, and yet he concludes by reasserting that on his principles "a true chemical calculus may be developed, in which we are enabled to reason by the agency of the same algebraic processes through which reasoning is conducted in arithmetical algebra."

Now, if an equation means anything in algebra, it is that one member may be substituted for the other, and yet if we perform this simplest of operations upon the very equations which Sir B. Brodie lays down we have *irreconcilable contradiction*.

Sir B. Brodie says that his equations are not to be multiplied and divided, but the fact is I did not introduce any more factors than he himself habitually uses. He constantly takes—

$$xxx = x + x + x.$$

All I do is to substitute for xx its value $x + x$, given in the third fundamental equation. We get $x\,(x + x)$, which the second fundamental equation states to be $xx + xx$, and this again is $x + x + x + x$, in contradiction of the former result.

I can perfectly understand that after Prof. Brodie has in the equation $xy = x + y$ asserted multiplication to be the same as addition, that it is no longer possible to allow multiplication, but this is hardly in accordance with *symbolic analogies* which are involved throughout the paper.

When I find that Professor Williamson is reported to have said at the Royal Society, on the 20th of June (see LABORATORY, p. 231), that "the introduction of algebra into chemistry, for reasonings like those to which Sir B. Brodie has applied it, is a step of incalculable importance." I think that he, as well as some other chemists who have discussed the paper, cannot have investigated the supposed groundwork of the calculus. I have no hesitation in asserting that there is nothing in these symbols which is *both new and true* beyond the old symbols of the chemical elements. I assert that xy no more involves true notions of multiplication or symbolic analogy than does HCl. It is impossible, in fact, to interpret a *weight multiplied by a weight*. You can add a *pound to a pound*, but you cannot multiply them. Sir B. Brodie, indeed, puts the matter into the language of operations. He says, we begin with the unit of empty space (1); we operate upon it with x and get $x.1$ (the weight x); then we operate again ($y.x.1$) and get the weight $y+x$. I deny that the second operation is the same as the first. *To add further weight* is not a repetition of the operation *to turn space into weight*.

To learn what a compound operation means we have only to turn to the celebrated paper of the late Mr. D. F. Gregory, in the 'Edinburgh Philosophical Transactions' (vol. xiv, p. 212), which Prof. Brodie quotes in support of his notion that there may be symbols obeying the law $xy = x + y$.

Mr. Gregory says—"What, then, will the compound operation $b\,(a\,(x))$ represent? If x represent a point, $a\,(x)$, which is the transference of a point to a rectilinear distance, or the tracing out of a straight line, will stand for the result of the operation, and then $b\,(a\,(x))$ will be the transferring of a line to a given distance from its original position. In order to effect this the line must be moved parallel to itself, the effect of which will be the tracing out of a parallelogram."

Each operation here adds a new dimension of space, and of course we cannot interpret anything beyond the third dimension of space. Now, even if we be allowed to represent chemical operations as turning space into weight, I deny that we can repeat the operation and carry any interpretation with us.

My meaning will be made most plain, perhaps, by the following comparison:

Gregory's symbols	x	$a(x)$	$b(a(x))$.
Meaning	Point.	Line.	Parallelogram.
Chemical symbols	1	$1.x$	$1.x.y.$
Brodie's meaning	Space.	Weight.	*Increased* weight.
True meaning	Space.	Weight.	*Inconceivable.*

The proper symbolic representation of a compound weight in chemistry is $x + y$, and if we import the notion of space it must be as in $o + x + y$, where $o =$ weight of the empty unit of space. I deny that Sir B. Brodie has any right to use the language of multiplication, calling the elements *prime factors*, and representing a compound by xy, when all along he is dealing only with addition and subtraction. Especially I am unable to see how he is warranted in saying that he is enabled to give to xy, "as the symbol of a compound weight, an exact interpretation in harmony with symbolic analogies."

It will now be apparent why Professor Brodie will not allow his equations to be multiplied or divided, namely, because he has given the name of multiplication to what is not multiplication. But, as it happens, he has himself, in the fundamental equation—

$$x(y + y_,) = xy + xy_,$$

performed multiplication under characteristic circumstances; hence it is that by mere substitution (which must be permitted in anything partaking of the nature of an algebraic calculus) we arrive at *irreconcilable contradiction*.

I am, Sir, your obedient servant,

W. STANLEY JEVONS.

Owens' College, Manchester; July, 1867.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

On the Compounds of Picric Acid with Hydrocarbons, and on their Use in Analysis. By M. BERTHELOT.*

1. *Preparation.*—These compounds may be formed by direct combination, and without the intervention of any solvent; but in order to obtain comparable results, the author has uniformly operated with *solutions of picric acid in ordinary alcohol, saturated at* 25° *to* 30°, the reaction being effected in such a manner that the desired compound may separate from a liquid previously saturated with the picric acid and hydrocarbon, this liquid finally remaining saturated with the compound, and nearly saturated with picric acid. These compounds have, indeed, but little stability, and are easily resolved by an excess of the solvent into picric acid and hydrocarbon: hence, if an alcoholic solution of picric acid, saturated at a lower temperature, as at 0°, or even at 10°, be used, the formation of the compound is partly, if not entirely, prevented by the too great proportion of alcohol present. On the other hand, when alcoholic solutions of picric acid, saturated at higher temperatures, as at the boiling-point, are employed, the results are often complicated by the deposition of picric acid as the liquid cools.

The reaction of alcoholic solutions of picric acid upon hydrocarbons has been effected under three different conditions, each of which is characteristic for certain bodies.

(1) *The hydrocarbon is dissolved separately in ordinary or absolute alcohol, so as to obtain a solution saturated at ordinary temperatures (by agitation, or by cooling), and this solution after filtration is mixed with the alcoholic solution of picric acid.*

Naphthalene thus treated yields immediately, or on agitation with a glass rod, a characteristic precipitate crystallised in fine yellow needles. Moreover, it appears to be the only crystallised hydrocarbon which yields a precipitate under the precise conditions above specified. Others, which are likewise capable of forming crystalline compounds with picric acid, are much less soluble than naphthalene in cold alcohol: consequently their alcoholic solutions saturated in the cold do not precipitate picric acid; nevertheless, a picric precipitate may sometimes be obtained with these hydrocarbons when they are dissolved in the pyrogenic liquids which sometimes accompany them, because these liquids holding the hydrocarbons in solution, often dissolve in cold alcohol more easily than the crystallised hydrocarbons themselves. In such cases the precipitate must be utilised for separating the hydrocarbon, the reaction of which with picric acid may then be studied in the manner presently to be described.

(2) *The hydrocarbon is dissolved in hot alcohol, and the mixture, while still hot, is mixed with an alcoholic solution of picric acid saturated at ordinary temperatures.*—This mode of operation is successful in most cases; nevertheless, the following is sometimes preferable:

(3) *The hydrocarbon is dissolved with aid of heat in an alcoholic solution of picric acid saturated at ordinary temperatures, and the mixture, after boiling for a few seconds, is left to cool.* The picric compound is then deposited during cooling, either immediately or after some hours.

It may here be remarked that picric acid often facilitates the solution of a hydrocarbon in boiling alcohol; or, to speak more precisely, the body which dissolves in the hot alcohol is not the hydrocarbon itself, but its picric compound. Hence the formation of characteristic and copious precipitates is sometimes observed with hydrocarbons which, when pure, are insoluble in boiling alcohol, such, for example, as benzerythrene.

Under the conditions above defined, characteristic picric compounds may be obtained with naphthalene, retene, anthracene and its homologues, chrysene (triphenylene), benzerythrene, and the hydrocarbon,

* 'Bull. Soc. Chim.' [2], vii, 30.

volatile at about 260°, contained in the crude anthracene of coal-tar.

On the other hand, no precipitate is obtained with benzene, cumene, or other homologues of benzene, nor with styrolene, although benzene and cumene, according to Fritzsche, and styrolene, according to Berthelot, are capable of forming picrates, when picric acid is dissolved directly in the hydrocarbon, and the solution is cooled or left to evaporate. These compounds, however, are not formed in alcoholic solution.

Neither is any picric compound formed in presence of alcohol, with phenyl or its homologues, with terebenthene and its numerous isomers, or with the numerous hydrocarbons of the formene series (C_nH_{2n+2}), the ethylene series (C_nH_{2n}), or the acetylene series (C_nH_{2n-2}), which have been examined by Berthelot, whose observations on this point agree with those of Fritzsche. The formation of the picric compounds may, therefore, serve for the detection and separation of certain classes of hydrocarbons.

2. *Characters of the Picric Compounds.*

(1) *Picrate of Naphthalene* ($C_{10}H_8$).—Beautiful stellate needles, visible even with the naked eye, better with the microscope, under which they appear as long sulphur-yellow prisms traversing the entire field of view. They are rapidly dissolved and decomposed by excess of alcohol. Their formation serves to distinguish naphthalene from phenyl, which often resembles it closely in external appearance, especially when isolated by sublimation.

(2) *Picrate of Retene* ($C_{18}H_{18}$).—Beautiful needles, resembling the naphthalene-compound in form, but distinguished by a much deeper orange tint. Moreover, this compound is not formed in an alcoholic solution of retene saturated in the cold.

(3) *Picrate of Anthracene* ($C_{14}H_{10}$).—Needles having the same form as the two preceding, but a very brilliant ruby-red colour, which likewise shows itself on surfaces where the mixture has evaporated and on the points of rods dipped into it. On carefully pressing the crystals between the glass plates of the microscope, the long needles split up into a multitude of truncated prisms, having a very peculiar aspect.

Picrate of anthracene is decomposed with peculiar facility by excess of alcohol; indeed, the red solution in which it is formed is decolorised by addition of even a small quantity of alcohol, and afterwards exhibits under the microscope the colourless curve-faced crystals of anthracene, mixed with only a few red needles of the picrate. The same effect is produced if the alcoholic solution of picric acid has been saturated at too low a temperature; to obtain good results it must be saturated at 30° to 40°.

The formation of the red needles is not confined to pure anthracene, but takes place likewise with the crude anthracene of coal-tar, which consists of true anthracene mixed with several less volatile and more fusible hydrocarbons homologous with it, also with chrysene and certain hydrocarbons having the composition attributed to paranaphthalene, $C_{15}H_{12}$. The production of a red picrate belongs, therefore, to a class of hydrocarbons rather than to anthracene in particular; and to identify the latter recourse must further be had to its melting-point, boiling-point, etc.

(4) *Picrate of Chrysene* (*Triphenylene*, $C_{18}H_{12}$).—The name chrysene is applied by Berthelot to a hydrocarbon obtained by the action of heat on benzene, and contained in small quantity in the crude anthracene of coal-tar. When its warm alcoholic solution is mixed with alcoholic picric acid saturated at ordinary temperatures, the mixture yields on cooling a yellow granular precipitate, which, if the proportions of chrysene and picric acid have been carefully adjusted, exhibits under the microscope the appearance of small yellow needles, grouped in tufts, quite different from the long needles formed by the preceding compounds. If the solutions contain an excess of chrysene, the yellow crystals of the picrate are mixed with the white transparent lance-shaped crystals of chrysene, which, however, do not alter the general appearance of the precipitate. If the chrysene solution contains benzerythrene (*infra*) the yellow tufts of the picrate become brownish, and diminish more and more in bulk till they degenerate into rounded masses resembling small drops of liquid fringed with microscopic needles.

(5) *Picrate of Benzerythrene.*—Benzerythrene is the orange-coloured solid resinous hydrocarbon which passes over, after the chrysene, in distilling the pyrogenous products of benzene.* It likewise accumulates in the last volatile products yielded by crude anthracene and by pitch. It is nearly insoluble in alcohol, even at the boiling heat. But on boiling it with an alcoholic solution of picric acid saturated in the cold, the liquid, as it cools, deposits a picrate in yellowish-brown flocks, which appear under the microscope to consist of extremely thin molecular granulations, having a tendency to aggregate in small brown heaps.

(6) *Picrate of Hydrocarbon volatile at 260°, contained in crude Anthracene.*—This is a lamellar hydrocarbon, distinct from naphthalene and from phenyl, which is met with in submitting to a series of methodical fractional distillations the most volatile portions of crude anthracene. A hydrocarbon of very similar character, and, perhaps, identical with this, occurs amongst the products of the action of ethylene on benzene. Neither of these hydrocarbons, when added in cold saturated solution to an alcoholic solution of picric acid, also saturated in the cold, forms any precipitate, a character by which they are distinguished from naphthalene; but if they are dissolved at the boiling heat in an alcoholic solution of picric acid saturated in the cold, the liquid, on cooling, deposits, after some time, a picrate in fine orange-coloured needles, similar in form to those of the naphthalene and anthracene compounds, and intermediate in colour. The large prismatic needles forming this compound are sometimes fringed with smaller needles joined to them at very acute angles, and these again with others still smaller, the whole presenting a very peculiar appearance. This picric compound is much more soluble than the picrates of

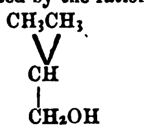
* 'Ann. Ch. Phys.' [4], ix, 459.

naphthalene and anthracene, and is more slowly deposited.

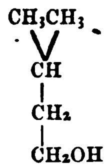
(7) *Picric Acid.*—As this acid often separates from solution in the free state, together with the compounds above described, the microscopic appearances of its crystals require to be carefully noted. When an alcoholic solution of picric acid evaporates quickly on the glass plate of the microscope, the plate becomes covered with a multitude of thin yellow laminæ, grouped like fern-leaves; but when the acid separates from alcohol by slow evaporation, or by cooling, it forms large irregular yellow prisms, perpendicularly truncated at one end, and terminated by unequal acuminations at the other. The crystals are known to belong to the trimetric or rhombic system. By the unequal development of certain faces, they often degenerate into pentagonal tables, having two sides perpendicular to the third, while the others meet at an angle of about 70°. Sometimes, on the other hand, the large prisms become shortened, forming crystalline grains, the three dimensions of which are comparable. Commercial picric acid sometimes exhibits, in addition to the above, yellow needles like picrate of naphthalene, either slender, short, and grouped in small numbers, or in large groups of long needles of a pure yellow colour.

On the Constitution of Amylenic Hydrate, and of Butylic and Anylic Alcohols as obtained by Fermentation. By E. Erlenmeyer.*

Experiments, which the author has not yet concluded, show that butylic acid and amylic alcohol, as obtained in the process of fermentation, are best represented by the rational formulæ—

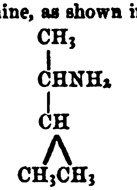


(Butylic alcohol.)

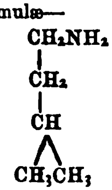


(Amylic alcohol.)

by which expression it is meant that butylic alcohol is methyl alcohol in whose methyl one atom of hydrogen has been exchanged for pseudo-propyl; and that amylic alcohol is ethyl of alcohol, in whose methyl one atom of hydrogen has been exchanged for pseudo-propyl. The amylenic hydrate of Wurtz is pseudo-proply alcohol, in which pseudo-propyl occupies the place of an atom of methyl; and the isoamylamine of the same chemist is related to ordinary amylamine, as shown in the formulæ—



(Iso-amylamine.)



(Amylamine.)

* 'Zeit. Chem.,' 1867, 117.

On the Composition of some Dried Fruits. By Fausto Sestini.*

The acidity of the fruits was estimated by means of an alkaline solution containing 20 grammes of caustic soda (½ eq.) to a litre of distilled water. The separation of the glucose was effected by dialysis, and the saccharometric estimation was made by Fehling's process.

The dates and plums were separated from the kernels, and after they had been weighed the experiments were made on the pulp alone.

7 dates	weighed 100 =	kernels 7·3 +	Pulp 92·7
15 dry white plums	„ 100 =	„ 21·2 +	„ 78·8
23 dry black plums	„ 100 =	„ 17·2 +	„ 82·8

	Water, per cent.	Anhydrous Glucose, per cent.	Solution of Caustic Soda saturated by 100 grms. of Fruit. c.c.
Dry figs, common	34·38	42·00	10·5
„ *à pièce*........	40·36	45·50	5·2
„ from Marseilles.........	32·67	48·35	5·3
Dates (without kernels)............	39·18	43·40	2·8
Raisins from Corinth (dried currants)	34·64	53·97	36·3
Dried raisins (*Zibibbo*)	37·83	54·00	17·3
Dried pears†	32·86	23·93	15·4
Dried plums from Marseilles (without kernels)	31·55	23·28	35·9
Dried white plums from Italy (without kernels)	33·09	31·95	56·2

On the Brominated Derivates of Gallic Acid. By E. Grimaux.‡

When bromine is gradually added to gallic acid, the mixture being facilitated by trituration after each addition, a brisk reaction takes place, the liquid quickly becoming decolorised and giving off copious fumes of bromhydric acid. The product consists of mono- or dibromo-gallic acid, according to the quantity of bromine employed.

To prepare monobromogallic acid, 1 molecule (2 ats.) of bromine is added to 1 molecule of gallic acid (about equal weights); the product is dissolved in five or six times its weight of boiling water; and the filtered solution is left to evaporate in dry air in presence of sulphuric acid; monobromogallic acid is then deposited in crystals after a day or two, and the mother-liquor yields colourless laminæ of dibromogallic acid.

Monobromogallic acid—

$$C_7H_5BrO_5 = C_6HBr\left\{\begin{matrix}CO_2H\\(OH)_3\end{matrix}\right.$$

crystallises by spontaneous evaporation in small, shining, transparent, yellow, hexagonal plates, which become white and opaque at 100°. From its concentrated boiling aqueous solution, it separates in slender colourless needles. It is very soluble in boiling water, slightly soluble in cold water, dissolves

* 'Bull. Soc. Chim.' [2], vii, 236.

† The smallness of the quantity of glucose in these dried pears (from Forli, in Romagna) arises from the practice of immersing them in boiling water before drying them. This has the effect of rendering them more gelatinous, and enables them to keep better.

‡ 'Comptes rendus,' lxiv, 976 (13 Mai, 1867).

also in alcohol and in ether. It does not alter at 200°; but when heated above that temperature it melts, becomes coloured and decomposes, giving off bromhydric acid and leaving a carbonaceous residue. It oxidises readily in the air in the presence of alkalies. Lime-water and baryta-water give it a rose colour, changing to greenish and then to orange-yellow; with ammonia and potash it becomes orange-yellow; with ferric chloride, black.

Dibromogallic acid—

$$C_7H_4Br_2O_5 = C_6Br_2 \begin{cases} CO\ H \\ (OH)_3 \end{cases}$$

is obtained at the same time as the monobrominated acid, but is more easily prepared by triturating gallic acid with excess of bromine. The formula of gallic acid shows that it cannot yield a tribrominated derivative. On triturating gallic acid with two or three times its weight of bromine, and digesting the product with three times its weight of boiling water, the solution, on cooling, deposits dibromogallic acid in long needles or prismatic laminæ, which are brittle, shining, and colourless, or sometimes tinged with yellow. At 100° it becomes slightly coloured, but retains a molecule of water, which it does not give up even at 120°. At that temperature it becomes opaque and coloured; at 140° it begins to melt and decompose; and above 200° it gives off a large quantity of bromhydric acid, leaving a residue of charcoal.

Dibromogallic acid is soluble in boiling water, slightly soluble in cold water, soluble also in ether and in alcohol. In presence of alkalies it becomes quickly coloured on exposure to the air. A few drops of lime- or baryta-water impart to it a bright rose colour, changing, on addition of a larger quantity of the reagent, to a very light green. The resulting solution, on exposure to the air, rapidly darkens and acquires a very rich red colour. On adding an ethereal solution of the acid to baryta-water, the mixture acquires a fine indigo-blue colour, changing to red on addition of water. Ammonia, potash, and soda, colour it orange-red, changing to rose-red in dilute solutions. With ferric chloride it acquires a black-blue colour.

Recreative Science.—A penny contemporary 'The World of Science' lately edified its readers by an article on the inflammable liquid said to have been prepared for the Fenians. This liquid, which is simply a solution of phosphorus in bisulphide of carbon, is introduced to young chemists as a subject for recreative experiment. "Much amusement," we are told, "may be created by the following experiment:—Moisten the finger with the solution, and make marks upon the face; for example, draw lines across the eyebrows and round the mouth, with a large spot at the end of the nose. In the dark a most hideous appearance will be presented, the lines and spots being indicated by blue fire." We are further informed that this experiment is quite harmless. Is the writer prepared to illustrate its harmlessness by applying the solution to his own skin?

VARIA.

Our readers will be glad to learn that Professor Adolphe Wurtz, F.R.S., of the École de Médecine, Paris, has promised to contribute to our pages. We hope to publish an original communication from this distinguished chemist in an early number.

Part XL of Watts's 'Dictionary of Chemistry' has just appeared. It is devoted to the compounds of sulphur.

The 'Morning Post' tells the story of the Albert Hall. In the early part of last year a body, consisting of one hundred and fifty gentlemen of the first eminence, denominated vice-patrons, met at Marlborough House, and passed resolutions in favour of building a Central Hall of Arts and Sciences. The Commissioners of 1851 undertook to provide a site worth £60,000, and to guarantee a sum of £50,000. For the remainder of the total sum of £200,000 necessary for the completion of the building, £150,000 were offered to public subscription, and it was generally understood that until that amount was covered no steps would be taken for commencing the hall. Subscriptions were solicited and obtained to the amount of £112,000. In the month of June, 1866, however, the whole matter fell into abeyance, and was for some time enveloped in silence. At length, in April, 1867, the subscribers, to their surprise, received three documents from the committee, viz., a copy of a charter already promulgated, but with the contents of which they had till then never been made acquainted; a call letter, and forms for payment; and a document announcing the laying of the first stone in May, and stating the fact that the committee had entered into an agreement with Messrs. Lucas, the contractors, by which the latter undertook to complete the building for £199,748, while they would take up the £38,000 which the public had not subscribed. By the original proposal each subscriber of £100 was the holder of one of 2000 seats fully subscribed, out of which only 500 could be sold by any one party. By the new arrangement he is the holder of one out of 1620 seats fully subscribed, including the Commissioners' 500; while a new element is introduced, of Messrs. Lucas with 380 seats, which, from the very nature of things, they must sell on the earliest possible opportunity. If the hall be completed, therefore, a subscriber to the amount of £100 will find himself the possessor of a property for which he has given £100, but of the same nature as property which Messrs. Lucas may perhaps be disposed to sell for £50. Besides this, it may be asked, what security is there that the hall will be built? The subscribers are not represented on the provisional committee, and they are debarred from any examination into accounts until within twelve months after the opening of the hall; and if, notwithstanding their payments, the hall is never completed, they will never have the opportunity of inquiring at all.

We should like to have full particulars of a startling application of electro-magnetism thus noticed in the 'Athenæum':—A fixed electro-magnet is placed opposite an opening in the side of the furnace containing the metal to be smelted, and a current of magnetism is directed into the molten metal. The effect on the iron is said to be very remarkable, rendering it extremely tough and hard. The process is carried on with great success at one of the most important ironworks in Sheffield.

Errata.—In our report of Prof. Williamson's paper, printed in No. 13, there are some trifling typographical errors, which our readers are requested to correct. On page 231, in line 12 of first column, instead of the word "weighs" the word "*weighing*" should be written; and in line 19 the words "These are" should be altered to "*we then have.*" These corrections will render the passage perfectly clear. Again, on page 232, in lines 2 and 3 of first column, the words "an entirely different hypothesis" should be altered to "*on* entirely different *hypotheses*."

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

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THE LABORATORY:

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CONTENTS.

THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science.

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W. M. Watts, D.Sc., Principal Assistant in the University Laboratory, Glasgow.
C. Greville Williams, F.R.S.
Adolphe Wurtz, Paris.

Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzo-salicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *On Chlorophyll*, by Mr. Tichborne; *On a New Form of Sand Battery*, by Father Secchi; *On Brodie's Chemical Symbols*, by Mr. W. S. Jevons; *On a Method of Determining Vapour-Densities*, by Dr. Watts; *On London Waters*, by Prof. Wanklyn; *Calculus of Chemical Operations*, by Sir B. C. Brodie; *On Affinity and Electricity*, by Georges Salet; *Geber*, an Historical Study.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise Editorial Articles, Critical Reviews of Books, practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

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Back Numbers can yet be obtained.

A COURSE OF SIX LECTURES ON COAL-GAS,

DELIVERED AT THE ROYAL INSTITUTION OF GREAT BRITAIN.

BY

EDWARD FRANKLAND, F.R.S., ETC.

LECTURE VI.*

Diluents continued—Function of the diluents—Vapour of benzole taken up by hydrogen—Marsh gas converted into an illuminant—Comparative innocuousness of the different diluents—Illuminants—Acetylene—Processes of Berthelot, Davy, and McLeod—Olefiant gas—Benzole—Naphthalin—Relative value of illuminants in different gases—Illuminating power of gas from various coals—Chemical composition of gas coals—Gas from Leeswood cannel—Cost of gas as an illuminating agent—Gas supplied to different towns—Bad quality of London gas—Conclusion.

COAL-GAS, when purified, contains two classes of constituents, namely, *diluents* and *illuminants*. The former emit little light in burning, but they perform a very important function, and indirectly contribute to the light of the coal-gas flame. They are capable of absorbing or taking up the luminiferous hydrocarbons, such as enter into the composition of coal-tar and coal naphtha, the solid and liquid products of the destructive distillation of coal. After the crude gas leaves the retorts the vapours of these hydrocarbons become condensed to a great extent, but a certain proportion of them remains diffused in the diluents, and thus escapes condensation. The importance of this function of the diluents will be perceived in a moment when we see the effect produced by the combustion of a hydrocarbon vapour diffused through a gas that burns by itself with a non-luminous flame. I have here some benzole, one of the products of the destructive distillation of coal. This body, which contains six atoms of carbon and six atoms of hydrogen, contributes in an important degree to the luminosity of the coal-gas flame. Its vapour is taken up by the diluents as well as by the gaseous illuminants and carried into the flame, where it burns with a bright white light. I will now pass a stream of hydrogen through this flask containing benzole, and convey a second stream from the same source directly to an ordinary fish-tail burner, where, as you perceive, it burns with a non-luminous flame. I now ignite the gas that has passed through the benzole, and, as you see, I obtain a flame that emits a considerable amount of light. In fact, we might be content with such gas as this for illuminating purposes, but we do not get in ordinary gas anything like such an amount of benzole vapour as is present in the flame now burning before us. [The experiment was performed as described.]

In addition to this function of taking up the volatile hydrocarbons, one of the diluents, namely, marsh gas, or light carburetted hydrogen, is capable also, under favourable circumstances, of producing a certain amount of light. We do not get any light from it under the ordinary circumstances attending the combustion of gas, but by taking advantage of an elevation of temperature in the air which supplies the gas flame, we may obtain a certain degree of luminosity, so that this marsh gas may be said to stand on the border-line between the diluents and the illuminants. If I employ the charcoal furnace which we used before for showing the increase of light by heating the air and gas before combustion, and pass through the tube in the centre of it a stream of marsh gas, you perceive from the luminosity of the flame that we have converted our diluent into an illuminant of no inconsiderable power. [Experiment.] This is doubtless one of the causes of the great increase in the illuminating effects we obtain by heating the air before it comes in contact with an ordinary gas-flame, inasmuch as this marsh gas enters very largely into the constitution of coal-gas, as seen from the diagram exhibited in the last lecture.* By thus bringing out the illuminating effect of the marsh gas, we obviously get a considerable increase of light.

Unfortunately, in the manufacture of coal-gas we have very little choice as to which of the diluents shall dilute the gas. We cannot very considerably affect the proportions which I gave to you in the last lecture. If we could choose between them we should probably select hydrogen in preference to carbonic oxide or marsh gas, though it must be admitted that each of the three diluents has its defects as well as its advantages. Hydrogen is perfectly innocuous, and may be breathed with impunity; moreover, it forms a perfectly innocuous product of combustion, namely, water. It produces, too, on combustion, a comparatively small amount of heat. The diluent of our coal-gas being hydrogen, we should have the temperature of the apartment slightly lower than if the diluent were carbonic oxide, and much lower than if it were marsh gas. But hydrogen has this defect, that it is more likely to produce an explosive mixture with the air of the apartment into which it might accidentally escape in an unburnt state. Any leakage of gas of that kind would be fraught with much more danger, because the range of explosiveness in mixtures of hydrogen with air is much wider than that of mixtures of marsh gas or carbonic oxide with air.

Now, carbonic oxide scarcely elevates the temperature of a room perceptibly more than hydrogen, and it forms an explosive mixture with more difficulty than either hydrogen or marsh gas; but it is excessively poisonous. It is the material which, in all probability, kills in the process of suffocation by the fumes of charcoal. In fact, when present to the extent of 2 per cent. in atmospheric air it proves fatal, and, certainly, recovery from its effects would be much more doubtful than from the effects of a similar quantity of carbonic acid. Again, too, in burning it produces its own volume of poisonous carbonic acid,

* See pp. 11, 33, 129, 169, 207.

* See LAB., June 22, p. 210.

The third diluent, marsh gas, is in itself perfectly innocuous. The labourers in coal mines can breathe an atmosphere containing 11 per cent. of this gas without any deleterious result, and they are, in fact, unconscious of its presence from any effect it produces on the system, or from any odour proceeding from it. I have myself breathed for half an hour in an atmosphere of this kind without being at all conscious of the presence of the marsh gas, except the intimation given by my safety-lamp that the atmosphere was explosive. It is also less likely than hydrogen to form explosive mixtures, supposing it to escape accidentally from a gas-pipe. Under peculiarly favourable circumstances, as we have seen, it is capable of furnishing a not unimportant quantity of light, but it consumes four times as much oxygen as either carbonic oxide or hydrogen, and it generates on combustion the same noxious compound as the former, namely, carbonic acid. Further than this, it also heats the atmosphere in which it is burnt three times as much as the same volume of carbonic oxide or hydrogen; so that, upon the whole, we should be inclined to give the preference to hydrogen, notwithstanding its greater tendency to form an explosive mixture with air.

We have now to consider the third class of constituents in coal-gas, namely, the *illuminants*. The names and chemical formulæ of these luminiferous bodies are given with those of other less important constituents in the table already referred to.*

Of the different families of illuminants the olefiant gas family and the benzole family contribute by far the largest amount of light to the gas flame. That very little is contributed by the hydrogen group (comprising the hydrides of hexyl, octyl, and decyl), we may convince ourselves by passing coal-gas through bromine. [Experiment performed.] The gas enters the bromine with its ordinary illuminating power, but on leaving the bromine it gives a mere ghost of a gas-light. The feeble light of the flame is due to the illuminants of the hydrogen family, which are not affected by the bromine.

The first of the illuminants which it will be necessary for us to notice somewhat in detail is acetylene. This gas, on account of its recent investigation, and from certain peculiarities it possesses, is specially interesting, though, perhaps, more to the gas-manufacturer than to the consumer. Acetylene is a constituent of coal-gas and is probably never absent from that gas. It possesses the peculiarity of producing a red precipitate when brought into contact with subchloride of copper, forming acetylide of copper. This acetylene may be produced by a variety of processes. The one which, perhaps, most interests us, as being that from which possibly the acetylene in coal-gas is derived, consists in applying a very high degree of heat to marsh gas. Marsh gas, if heated much higher than when it is ignited in atmospheric air, is transformed into acetylene. That it does not suffer this transformation when burnt in atmospheric air we know from the lightless flame which it gives. Acetylene is an illuminant of a very high power, and it is not improbable that when atmospheric air is previously heated for the supply of the marsh gas flame, acetylene is produced, which forms the illuminating ingredient in that flame under such circumstances. Here is a little apparatus by which the production of acetylene from marsh gas can be illustrated. Here is a gasholder containing marsh gas, and I will pass the gas through a flexible tube into a glass vessel containing pieces of coke, placed at the ends of copper wires which carry the electric current from an induction coil. Through this glass vessel the stream of marsh gas passes into a flask containing an ammoniacal solution of subchloride of copper. The result is that the surface of the liquor immediately becomes red, with a floating film of acetylide of copper, and you may observe how rapidly the blue solution is also becoming of a red colour. The electric sparks strike through this stream of marsh gas, and heat the particles of marsh gas which are near to it very highly, indeed far beyond the temperature to which we can heat them, even when burning marsh gas in heated air.

In the second place, acetylene can be produced, and, in fact, it was thus first produced by Edmund Davey, by bringing into contact with water a singular compound obtained in the manufacture of the metal potassium. When this metal is obtained from a mixture of carbonate of potash and charcoal, there is formed a compound of potassium with carbon, which deposits in the neck of the retort, and is a great obstacle to the production of potassium. Edmund Davey found that when this substance was brought into contact with water, it gave off a peculiar gas which possessed a very high illuminating power, and contained in the same volume only half as much hydrogen as olefiant gas contains. Much more recently this gas has been rediscovered by Professor Berthelot, who has succeeded in producing acetylene directly from its elements. He has found that by igniting very intensely a piece of carbon in an atmosphere of hydrogen, acetylene is formed though not in large quantities. This experiment is very interesting in connection with the theory of the light of a gas-flame, for it might perhaps be objected, in connection with this theory, that the luminous hydrocarbons I have spoken of as the sources of light, would be decomposed at the high temperature of the flame. It is true that some are decomposed at a bright red heat; but here is one which is actually generated from its elements at a temperature infinitely higher than that of any gas-flame; for M. Berthelot employs the highest temperature ever produced—viz., that of the electric arc—for the production of this illuminant. Here is a glass cylinder through which a current of hydrogen is passing. Through two openings in this cylinder are inserted the coke poles of a powerful galvanic battery. If I bring these poles together I get in the interior of the hydrogen the electric light. This light is, as you are aware, produced by the intense ignition of the carbon poles which are conveying the current, and these pieces of carbon are here ignited in an atmosphere of hydrogen. This hydrogen, after passing through the cylinder, is conveyed through a flexible

* See Lecture, LAB., April 20, p. 35.

tube, and into a vessel containing ammoniacal solution of subchloride of copper.

The fourth process by which acetylene is produced is the imperfect combustion of hydrocarbon gases or vapours. A convenient contrivance for the carrying out of this process has been devised by Mr. McLeod, and is now upon the table before you. It is a modification of the apparatus which we used in a previous lecture for burning atmospheric air in coal-gas. There is a tube conveying atmospheric air into the interior of a cylinder, and a second tube conveying coal-gas into the same cylinder. They are both drawn in by the action of a powerful water aspirator, which causes the stream of gases to pass rapidly through the apparatus. The kind of combustion which goes on when air is admitted into coal-gas, instead of coal-gas into air, is favourable to the formation of acetylene. A large quantity of this body is formed under the circumstances, and it passes through these cylinders, which are filled with an ammonical solution of subchloride of copper. [Mr. McLeod's process for preparing the acetylide of copper was carried out before the audience.]

The red compound produced in all these processes is very convenient for the preparation of pure acetylene, inasmuch as it separates the acetylene from the other gases, and can afterwards be made to yield it up in its pure condition. Here is a specimen of this acetylide of copper. It is a red, amorphous substance which is perfectly insoluble in water, it explodes when struck with a hammer, or on being suddenly heated to a temperature only a little beyond the boiling point of water. This body, which is thus capable of exploding by friction and by elevated temperature, is probably the cause of certain gas explosions which have occurred from time to time, and of which the reason could never be discovered. This substance is liable to be formed when the coal-gas comes in contact with the brass fittings of gas-meters, and there are some instances on record in which gas-meters, having been detached from service-pipes and brought out into the open air, have suddenly exploded on the workmen proceeding to unscrew some of the brass fittings. The presence of minute quantities of acetylide of copper which, by the friction caused by the unscrewing of the joints, have exploded and have ignited the mixture of coal-gas and air in the meter, would account for such accidents.

Acetylide of copper dissolves without decomposition in dilute hydrochloric acid, but if the solution be heated, it is immediately decomposed, chloride of copper being formed and acetylene gas produced.

Acetylene is a colourless and transparent gas, having a peculiar and rather unpleasant odour; its specific gravity is slightly less than that of air, being ·92, or just thirteen times heavier than hydrogen; it is tolerably soluble in water, and burns with an intensely luminous flame. [Experiment performed—acetylene gas being burned from a fishtail burner.] Acetylene, when added to chlorine, explodes even by the action of diffused daylight. This explosion is attended with a very slight report, but with the evolution of a large quantity of carbonaceous smoke. [Experiment performed.] If we reverse the experiment, and add the chlorine to the acetylene, then the explosion takes place immediately, even in perfect darkness. [Experiment performed.] It is difficult to account for this difference in effect in the two cases.

The next illuminant that we must notice is olefiant gas, which is a colourless transparent, and therefore invisible gas. It burns with a beautifully brilliant flame, not nearly so bright, however, as that of acetylene, because it contains in an equal volume the same amount of carbon, and twice as much hydrogen, as the last-named gas. It is slightly soluble in water, requiring about twelve times its bulk for solution.

The next illuminant, which also belongs to a different family, is benzole. This is contained in coal tar, and also in coal naphtha which is distilled from coal tar. It is a limpid, colourless liquid, which refracts light strongly, solidifies at the freezing point of water, and boils at 177° Fahr. A large quantity of its vapour can, therefore, be taken up by the diluents in coal-gas, as was seen when we passed hydrogen gas through a flask containing this liquid. Some time since this material was proposed to be used for what may be termed portable gas. The contrivance for thus burning benzole consisted in first mixing it with about two volumes of alcohol, and then introducing the mixture into a glass globe, in the neck of which was inserted a brass tube, containing an ordinary wick, reaching nearly to the top of the tube. The top was closed by a cap, and around the circumference of the cap was a row of little apertures. On heating the top of the wick, which was saturated with benzole, the temperature of the brass above the wick soon became sufficiently high to volatilise the benzole, and the gas or vapour of the benzole then burnt in little jets.

Another illuminant to which I have alluded is naphthalin, one of the most beautiful crystalline bodies with which chemists are acquainted; but, whilst it is practically valueless to the consumer, it is a great annoyance to the manufacturer of gas; for this substance, being volatile, is carried along with the gas into the street-mains as a colourless and invisible vapour. By the gradual diffusion of the hydrogen and other constituents through the joints of the pipes and also by the lowering of the temperature in the pipes the gas becomes super-saturated with the naphthalin, so that large masses become deposited in the mains, and produce obstructions which it is very difficult to remove. This naphthalin is capable of contributing very largely to the illuminating effect of a gas-flame, if it can be introduced at a sufficiently elevated temperature; but under all practical circumstances we may put its illuminating power in a gas-flame at *nil*. We have here some hydrogen gas which is passing over naphthalin at the ordinary temperature, and you observe that on lighting it we do not get any additional luminosity. But if I warm the naphthalin, so that its vapour may pass up with the hydrogen, we get a brilliant flame; indeed, far more smoky matter is produced than can be consumed.

The following table gives the results of experiments upon the comparative value of the illuminants in gases obtained from different varieties of cannel and coal:

Relative Value of Illuminants contained in various Cannel and Coal Gases.

Volume and Light of Illuminants containing same Weight of Carbon as 1 Cubic Foot of Olefiant Gas.

	Volume.	Light.
Cannel Gases.		
Boghead	0·79 cubic ft.	2·80 candles.
Lesmahago	0·58 „	2·58 „
Newcastle	0·57 „	2·88 „
Wigan	0·71 „	2·95 „
Methley	0·78 „	3·04 „
Coal Gases.		
Newcastle	0·54 „	4·23 „
City Gas Campany's	0·44 „	3·73 „
Great Central	0·49 „	3·91 „

From this table it will be perceived that the illuminating effect of the hydrocarbons contained in cannel gas is directly proportional to the amount of carbon contained in a given volume. Thus ·57 cubic foot of the luminous hydrocarbons in Newcastle cannel gas contains as much carbon as ·79 cubic foot of the hydrocarbons in Boghead cannel gas, and these volumes give also the same amount of light on combustion. The same appears to be the case with the illuminating hydrocarbons in coal-gases when compared together; but the carbon in these last has a higher absolute illuminating value, weight for weight, than that contained in cannel gases. Thus equal weights of carbon in the hydrocarbons of Lesmahago cannel gas and Newcastle coal-gas give, respectively, the light of 2·58 and 4·23 candles. The cause of this difference is probably due to the carbon in the hydrocarbons of coal-gas being associated with less hydrogen than that in the hydrocarbons of cannel gas. The hydrocarbons of the latter are of the same type as acetylene, whilst those of coal-gas have more resemblance to olefiant gas in their constitution.

Now, in the evolution or generation of gas in the process of manufacture, the quality of the gas depends, to a considerable extent, upon the conditions observed in the operation. The first and most important condition is the quality of the material which is employed in the manufacture. We have on the table before us various specimens of cannel and coal. There is also a specimen of a valuable material recently discovered in New Brunswick—the Brunswick cannelite—for which I am indebted to Mr. Archibald, and which produces gas in large quantities and of good quality. The illuminating power of gas from different descriptions of coal is expressed in the following diagram:

Illuminating Power of Gas from various Coals.

Name of Coal.	Consumption of Gas per Hour.	Light in Standard Sperm Candles.
Brunswick cannel	5 cubic feet	52·6
Lesmahago	5 „	40·0
Brunswick cannelite	5 „	37·8
Newcastle cannel	5 „	34·4
Methill	5 „	27·8
Wigan	5 „	22·1
Newcastle coal	5 „	14·9

The value of these materials, for gas-making purposes, varies with the proportion of hydrogen to carbon in the coals, but appears to be independent of the proportion of oxygen to carbon, as may be seen from the following comparison:

Proportion of Carbon to Oxygen and Hydrogen in various Gas-Coals.

	C.	H.	O.
Wigan	100	7·67	12·08
Boghead	100	13·96	8.36
Lesmahago	100	10·38	13·29
Pelton	100	6·21	10·38
Methill	100	11·79	13·99

Then the temperature at which gas is manufactured exercises a very material effect upon the quality of the gas. If the temperature be too high, if the retorts be heated too strongly, a large volume of gas is produced, but it is of inferior illuminating power, and of inferior quality as regards the irremovable sulphur compounds. In fact, in such an operation some of the gaseous hydrocarbons, which ought to be decomposed in the flame, are decomposed before they leave the generating apparatus, so that the production of gas at a great heat results in a great loss of illuminating power, though the quantity of gas manufactured is much larger. If, on the other hand, the temperature be too low, you fall into the opposite error, but you do not get a higher-quality gas; on the contrary, you get a lower quality than is produced at a bright red or cherry heat, which is about the proper temperature for making gas. You will see this strikingly illustrated in the manufacture of paraffin oil, in which large quantities of gas are produced of excellent quality as regards purity, and also of a tolerably high illuminating power. The results of the analyses of gases so produced from the Leeswood cannel, which is a very good cannel, giving at a bright red heat gas equal to Lesmahago—5 cubic feet giving the light of 40 candles—is seen in this table:

Composition of Gas from Leeswood Cannel, distilled for Paraffin Oil at 770° F.

Illuminating hydrocarbons	10·93
Marsh gas	44·99
Hydrogen	26·38
Carbonic oxide	4·61
Carbonic acid	13·09
Sulphuretted hydrogen	traces
Bisulphide of carbon	0·00
	100·00

Illuminating power of purified gas, 5 cubic feet per hour = 25 candles. One ton of cannel gives 4000 cubic feet of gas.

The principal point about this gas is that sulphuretted hydrogen is present in a very small quantity only, and the bisulphide of carbon is entirely absent. The illuminating power of this gas when purified from the large quantity of carbonic acid contained in it, and burning 5 cubic feet an hour, is equal to

25 candles, and in this process one ton of cannel, which under ordinary circumstances would yield 11,000 or 12,000 cubic feet of gas, gives only 4000 or 5000; so that low temperature, although very favourable to purity of the gas, is unfavourable to a good result as regards volume and illuminating power.

Then again, it is important to prevent undue pressure on the interior of the retorts, because the illuminating hydrocarbons are more rapidly decomposed by a high temperature when under pressure than when rarefied. I have already explained the position of the exhauster, and the action of this apparatus in preventing undue pressure in the retorts.

The following table exhibits a comparison of the cost of gas with that of other sources of light, from which the enormous advantage of gas as an illuminating agent will be seen:—

Comparative Cost of the Light of 20 Sperm Candles, each burning for 10 hours, at the rate of 120 grains per hour.

	s.	d.
Wax	7	2½
Spermaceti	6	8
Tallow	2	8
Sperm oil	1	10
Coal-gas	0	4¼
Cannel gas	0	3
Paraffin	3	10
Paraffin oil	0	6
Rock oil	0	7⅜

I have, lastly, to bring before you a table of the illuminating power of the gas supplied to the metropolis and that supplied to other large towns. Through the kindness of my friends in various places, I have been able, almost at the last moment, to get estimations of the illuminating power of the gases used in the principal European capitals, and in many of our British towns and cities, and the results of my inquiries are contained in this table.

Comparative Illuminating Power of the Gas supplied to various Cities and Towns.

Name.	Authority.	Illuminating Power in standard Sperm Candles.
European Capitals.		
Berlin	Hofmann	15·5
Paris	Frémy	12·3
London	Letheby	12·1
Vienna	Redtenbacher	12·0
Edinburgh	Penny	28·0
British Cities and Towns.		
Manchester	Leigh	22·0
Liverpool	King	22·0
Glasgow	Penny	28·0
Aberdeen	„	35·0
Greenock	„	28·5
Hawick	„	30·0
Inverness	„	25·0
Paisley	„	30·3
Carlisle	„	19·0
Birmingham	Frankland	15·0

The illuminating power given by Dr. Letheby, in London, of 12·1 candles is by the parliamentary burner, the unsophisticated burner mentioned and described in the Gas Act of 1860. In the improved Sugg's burner about 1½ candle more light would be obtained, owing to the better construction of that burner. In almost all the cases quoted in this table I have the certificates of the gentlemen, who have tested the gas at a recent period. The gas supplied to Berlin is partly manufactured from English cannel coal.

The following, with reference to the metropolitan gas supply, I take from Dr. Letheby's report on the gas delivered to the City. He states that, measured by the old parliamentary burner, the illuminating power of the gas supplied to the City before the passing of the Metropolis Gas Act in 1860, and when gas was sold at 4*s.* per 1000 cubic feet, was 13·2 candles; since the passing of the Act, and when the price of gas has been raised to 4*s.* 6*d.*, it has been only 12·1 candles. This is the average in both cases, but it has been as low as 9·6 in the case of the Chartered gas. There is no doubt that this depreciation is due chiefly to the retention of the carbonic acid in the gas by the new system of purification, for this carbonic acid remaining in the gas would deteriorate it to the extent of 11 or 12 per cent., which would just make the difference in illuminating power between 13·2 and 12·1 candles.

What, then, is our position in this great and wealthy city with regard to the supply of gas—in this the metropolis of the country which annually yields such vast quantities of the finest gas-coals in the world, and sends these coals half round the earth to illuminate the cities of other nations? An inspection of the table I have just referred to fails to convince me that we are fairly and considerately treated in this respect. Perhaps as consumers we are rather partial in the matter; but still we are entitled to be heard from our point of view. To obtain the light with which the inhabitant of Edinburgh or Glasgow illuminates his drawing-room, we have to burn double the amount of gas, and to have the atmosphere of our drawing-rooms contaminated with double the heat and moisture, and many times the amount of sulphurous acid. Some sixteen years ago I examined analytically and photometrically the gas supply of the metropolis, and I have no hesitation in saying that it was better then than now. How is this to be accounted for? Has invention, which has been so busy in improving other manufactures, left that of gas untouched? By no means. Improved retorts, exhausters, and purifying processes have been brought forward in abundance. Have, then, the gas companies disregarded these improvements? By no means. Whenever the improvement promised to reduce the cost of the manufacture of gas, they have eagerly adopted it. Thus, within the time I have just mentioned, they have revolutionised their process of purification, having adopted a method which greatly decreases the cost of that purification, and increases the volume of the gas, but which reduces its illuminating power by 11 per cent., and makes it utterly unfit for use in dwelling-houses, by leaving it contaminated with those sulphur compounds which,

on combustion, impregnate the surrounding air with stifling fumes of sulphurous acid. Thus an improvement which reduces the cost of production, but seriously deteriorates the quality of the gas, has been universally adopted, whilst inventions which have had for their object the improvement of the quality of the gas as delivered to consumers, but which have offered no advantage to the producer, have been, without exception, utterly ignored. I do not enter into the subject of price, though something might be said on this head, because, in a wealthy city like this, cost is, with most consumers, a secondary consideration. The man who spends thousands in furnishing his mansion has a right to expect, in the present state of science and manufactures, that his house shall be lighted with a material that shall not damage and destroy the works of art and the things of beauty with which he surrounds himself. He has, I conceive, a right to demand that, in this respect, he shall not be treated worse than the inhabitants of second or third rate towns. He is willing to pay any fair price for such an article, since, if the present price were doubled, it would still be far cheaper than that of any other illuminating agent; but he must have *good quality*, for without it, this grand invention of the century is lost to him. Let the metropolitan companies see to this in a liberal spirit, and let the consumers understand that low-priced gas is not necessarily cheap gas, and then we shall soon, I hope, have a gas of not less illuminating power than 20 candles per 5 cubic feet per hour, below which quality no gas is fit for domestic use.

ORIGINAL COMMUNICATIONS.

WATER ANALYSIS.

THE quantity of nitrogenous organic matter existing in even the worst kinds of waters is very small, and the chemical analysis required for discriminating between the degree of impurity of different waters is necessarily of the most delicate kind. These examples will serve in illustration. A million parts of Thames water, taken at London Bridge at two hours' flood, contained albuminoid matter equivalent to 0·35 parts of ammonia; a million parts of New River water contained in like manner 0·09 parts of "albuminoid" ammonia, whilst a million parts of a spring water which we have examined did not contain 0·002 parts. A litre of water was taken for examination in each case (and there is inconvenience and error in greatly increasing the scale of operation). We have, therefore, in these examples made measurements of 0·35, 0·09, and 0·002 milligrammes respectively; and we need scarcely add that in the whole range of chemical analysis there is hardly anything except ammonia estimated by the Nessler test which admits of a like degree of delicacy. The Nessler test will show one part of ammonia in twenty million parts of water, and that without any concentration. By taking advantage of the fact that a weak solution of ammonia evolves its ammonia on distillation, we are able to concentrate in the distillate, and so can still further increase the delicacy of the Nessler test.

Our method of detecting and estimating nitrogenous organic matters in waters consists, as we have said on a former occasion,* in transforming such matters into ammonia, and measuring the ammonia so produced. Inasmuch as by means of the Nessler test the estimation of ammonia has become more delicate than almost anything else, we are able to impart extrême delicacy to the chemical detection and estimation of these nitrogenous organic matters in waters.

If we reflect on the subject of drinking waters it will at once occur to us that the natural impurities most to be avoided are nitrogenou substances in incipient putrefaction, or in the still more terrible form of germs ready to burst out into parasitic life. As has been remarked, one cannot tell how little of such a substance may be capable of doing mischief, and hence the importance of having a reagent endowed with the most extreme delicacy, so that absence of reaction may be a fair sign of absence of the nitrogenous organic substances. We believe to have realised this in the present instance, and that waters which, when submitted to our test, show no signs of "albuminoid" nitrogen, are really free from matters in incipient putrefaction and from germs.

Some years ago (1852) a microscopic examination was made of sediments deposited by Thames and other waters in keeping.† The result of the examination was that Thames water, as supplied to London, contained living things, but that certain deep-spring waters were free from life.

Our result is parallel. The waters ordinarily supplied to London contain albuminoid nitrogen; the waters of certain deep springs contain absolutely no albuminoid nitrogen.

We hope to see the time when our towns, ceasing to be supplied with the waters of rivers or lakes, will derive their drinking water from deep springs which—although they may contain traces of ammonia of atmospheric origin, and although they may contain nitrates of atmospheric origin, or as the oxidation-products of organic structures which lived long ago in the geologic ages—are perfectly free from either putrescible or parasitic organic matters.

J. A. WANKLYN.

* *On Water Analysis, and the determination of Organic Matter in Water*, by Wanklyn, Chapman, and Smith, read before Chemical Society. See abstract in LAB., June 29, p. 241.

† *Vide* Reports made to the Directors of the London (Watford) Spring Water Company, by Lancaster, Redfern, Clark, and Smith

LABORATORY NOTES.

On Nessler's Test for Ammonia.

Preparation.—Dissolve about 50 grm. of iodide of potassium in a small quantity of hot distilled water. Place the vessel containing the solution on the water-bath, and add a strong solution of bichloride of mercury until the red precipitate, which is formed, ceases to be redissolved. Filter, add to the filtrate about 120 grm. of potash in strong solution. Make up to a litre, and then add a small quantity (5 c. c. or so) of the bichloride solution. Allow to subside and decant the clear liquid for use. It is as well to keep the quantity required for immediate use in a small bottle, and only to open the stock bottle to replenish it, as the solution becomes a little thick if much exposed to the air. The object of the addition of the second quantity of bichloride is to make the solution clear at once. If it be not added the test will appear to be clear, but will not remain so when added to an ammoniacal solution. Still, if the test, without this addition, be kept for a week or ten days, it will deposit a little, and is then as good as the solution to which the bichloride has been added.

Use of the test.—When a small quantity of the test is added to a solution containing a trace of ammonia, a yellow or brown coloration is produced. If more ammonia is present a precipitate is formed, and if we add the ammonia to the test we almost always obtain a precipitate. The test was, we believe, first employed to determine the quantity as well as the presence of ammonia, by the late Mr. Hadow in the laboratory of Professor Miller. The only printed account of the process, so far as we know, is contained in Professor's Miller's discourse "On some points in the Analysis of Potable Waters." The method we employ differs in no essential particular from the one there described.

In order to use the test quantitatively the following things are required:

(1) Distilled water, free from ammonia. In preparing large quantities of distilled water some portion of the distillate will usually be found to be devoid of ammonia. Distilled water containing ammonia may be purified by redistillation, when the first portion will be found ammoniacal, and the rest free from ammonia. Common water containing organic matter is apt to give off ammonia, late as well as early in the distillation; hence the advantage of redistillation from carbonate of soda.

(2) A solution of ammonia of known strength ($\frac{1}{10}$ of a milligramme in a c. c. is a convenient strength) obtained by dissolving 0·3882 grm. of sulphate of ammonia in a litre of water.

(3) A narrow burette divided into 0·1 of a cubic centimetre to measure the standard ammonia.

(4) A pipette to measure the Nessler test. It should deliver about one and a half c.c.

(5) Glass cylinders that will contain about 160 c.c., they are graduated at 100 c.c., and also at 150 c.c.

To estimate the ammonia, fill one of the cylinders with the solution to be examined, and add one measure of the test. Observe the colour, and then run as much of the standard solution as you think it corresponds to into another cylinder. Add as much water as is required to make the volumes in the two cylinders equal, and then add a measure of the test. Allow the liquids to stand for ten minutes. If the coloration is equal, the amount of standard ammonia used represents the ammonia in the fluid under examination. If not, another cylinder must be filled employing a different amount of the standard ammonia; and this must be repeated until the colours correspond. It is very seldom necessary to make more than two such comparative experiments. Each $\frac{1}{10}$ c.c. of the standard ammonia equals $\frac{1}{100}$ of a milligramme of ammonia, and in 150 c.c. of water the Nessler test gives a well-marked indication with $\frac{1}{20}$ c.c. of the standard. Ordinarily we employ 100 c.c. in the estimation, but if we are dealing with very small quantities 150 c.c.

We do not find it convenient to make an estimation in a solution that contains more than $\frac{1}{10}$ of a milligramme in the hundred c.c. Still, if a solution contains even ten times this amount, direct experiment has shown that a better estimation can be made by diluting, and then "Nesslerising," than by distilling out and titrating. Of this fact we have repeatedly convinced ourselves.

ERNEST T. CHAPMAN.

Laboratory of the London Institution.

On a change to which Sulphide of Ammonium is liable by long exposure to direct light.

SOME sulphide of ammonium, which had stood nine or ten months in front of a window through which the sun's rays often came, was added to a solution of copper, when, instead of the black sulphide, a liver-brown precipitate was occasioned, readily soluble in excess of the sulphide.

On heating the solution thus obtained, black sulphide of copper separated, but upon neutralising, the original compound reprecipitated.

The only metal this brown compound contained was copper, and that in combination with sulphur. Its properties were found to be identical with those of recently precipitated pentasulphide of copper; therefore, pentasulphide of ammonium must have been produced from the common sulphide, in all probability by the agency of the sun's rays, for I may mention that some of the same common sulphide that had been kept simply for the same period in a cupboard with glass doors behaved in the ordinary manner with metallic salts.

The altered sulphide solution was very yellow, smelt strongly of free ammonia, and contained a quantity of sulphur.

The above change may be thus represented:

$$6NH_5S + O_5 = (NH_4)_2S_5 + S + 4NH_3 + 5H_2O.$$

The foregoing observation would, of course, point to the advisability of keeping sulphide of ammonium as much from direct light as possible, and also of warning beginners in chemistry of the possibility of finding a *sulphide of ammonium* capable of making copper

appear to react in a similar manner to what antimony does with real sulphide.

Nature, as a rule, guards against this source of error, pentasulphide of copper being changed at once into the black sulphide by the addition of sulphide of ammonium.

ALFRED TRIBE.

EDITORIAL NOTES.

"THE LABORATORY" AND ITS SUPPORTERS.

OUR attempt to establish an independent weekly journal, addressed to the students and cultivators of experimental science, has proved that there is no lack of good material for such an organ. For fifteen weeks the pages of THE LABORATORY have been filled with original articles by eminent chemists and physicists, and our arrangements for the future enable us to include in our list of contributors the names of some of the most famous *savants* of France and Germany. With a few notable exceptions, the gentlemen to whom we submitted our plans at the commencement of the year, and from whom we received encouraging promises of support, have been regular contributors to the journal; and many writers, personally unknown to us, whose high position deterred us from soliciting their help, have voluntarily forwarded us important articles. The amount of help we obtain from our leading scientific men cannot be estimated by a reference to the contributions printed under the head of "Original Communications," as most of the leading articles, reviews, and abstracts, which appear in the journal without signatures are written for us by distinguished professors and authors. In Sir Benjamin Brodie's language, the editorial "we" may be defined as "the symbol of a combination of numerous prime factors."

Our desire to produce a high-class scientific organ has therefore been fully realised, and we might look forward hopefully to the future if our list of subscribers was proportional to our list of contributors. We must confess, however, that the present circulation of the journal is somewhat disheartening. Our earnest efforts to improve the tone of periodical scientific literature have called forth many warm expressions of approval, but have brought us comparatively few subscribers. A journal mainly sustained by contributions costing nothing might be profitably carried on with such a circulation as we have secured for THE LABORATORY, but this journal is conducted on ordinary commercial principles, and affords its contributors liberal remuneration for their literary labours. Unless the systematic payment of contributors can be kept up, we do not care to carry on the journal, for we have no faith in a literary undertaking that is dependent upon unpaid contributors.

We do not despair of the ultimate success of THE LABORATORY, and we shall not relax our efforts to render it the best English scientific journal until we have given it a fair trial. We trust, however, that the members of the scientific body will afford us the support which we think we deserve, and show that they are able and willing to sustain a thoroughly independent organ. THE LABORATORY was started as a medium of intercommunication for all persons interested in chemical and physical research, and its columns are open to every one who has new facts to communicate.

We think we may now fairly appeal to every worker in the broad field of experimental research for support, for we are convinced that THE LABORATORY has supplied a want that every chemist and physicist must have experienced. Surely in this great scientific and manufacturing kingdom there is a sufficiently large public to sustain an independent weekly journal devoted to chemistry and physics, and fed by paid contributors!

QUESTIONS OF PRIORITY.

OUR Paris correspondent last week gave an abstract of a paper on the formation of mixed ethers, submitted to the Academy of Sciences by MM. Reboul and Truchot. In this paper the authors record the observation that ethyl-hexyl ether is produced, together with hexylene, when chloride of hexyl is heated in a sealed tube with an alcoholic solution of potash. Mr. C. Schorlemmer, of Owens' College, Manchester, has called our attention to the fact that he made the same observation some months ago, and published it in a paper read before the Chemical Society, and printed in its Journal of September last.

A more important question of priority is discussed in a recently published pamphlet by Mr. H. B. Condy, entitled, '*Propriétés Désinfectantes des Permanganates Alcalins.*' From this pamphlet we learn that certain French writers have disregarded Mr. Condy's undoubted claim to the credit of having first discovered the disinfecting properties of the alkaline permanganates, and have attempted to persuade the world that the useful applications of these salts originated in the researches of MM. Demarquay, Le Dreux, and Castex. The facts so plainly set forth by Mr. Condy, and the reports and extracts printed in his pamphlet, prove that his discovery had been published in England and in France long

before any French chemist or physician advocated the use of manganates and permanganates as disinfectants. We shall return to the consideration of Mr. Condy's pamphlet on a future occasion.

THE SLIDE-RULE.

THIS little instrument, although well known amongst engineers, is, we believe, comparatively unknown amongst chemists. Its chief use for chemists would be to check their calculations, whether for mineral analyses, combustions, or gas analyses. It is well known, for instance, how much time and trouble is lost in checking the results, say of twenty combustions; now, with this simple contrivance, after very little practice, the whole of the values might be controlled in less than twenty minutes. We will briefly give the theory of its construction, and then show how it is practically used.

The slide rule, as shown in Fig. 1, is composed of three pieces, first, an ivory or boxwood scale, F G H K; secondly, the centre L M N P consisting of a piece of wood which slides in a groove, the face of the sliding piece being flush with the surface of the main scale; and, thirdly, a sliding piece of bronze Q R with four notches, *a*, *b*, *c*, *d*. This third piece may move up and down the rule without rubbing against the face, and so disturbing the sliding piece, L M N P.

On the fixed part of the rule there are two scales, A and D. On the sliding part there are two exactly similar, namely, B similar to A, and C similar to D.

The scale AA′ is divided thus:—The length AA′ is equal to 25 centimetres. This is divided into two equal parts at the point S, so that AS = SA′, and AS and SA′ are divided alike. Make a scale as long as AS, and divided into 100 parts. Lay it against AS. Look out in a

Fig. 1.

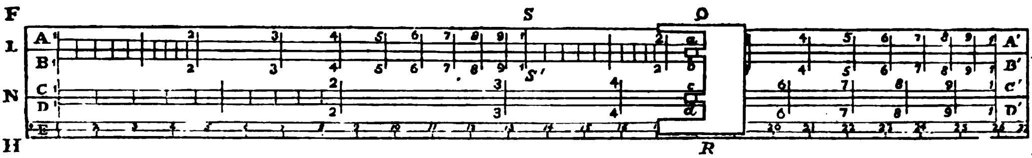


Fig. 2.

book the logarithms of the numbers 2, 3, 4, etc., namely, 301, 479, and 602, etc.

At a distance of 30·1 divisions of the scale applied to AS make a mark on AS, and number it 2; at a distance 47·9 divisions mark the scale AS,3; and at distance 69·9 divisions mark the scale AS, 5, and so on.

These distances are again divided ten times opposite numbers corresponding to logs. of 11, 12, etc., in a similar way, and a third time divided as far as convenient.

SA′ is a copy of AS, and BB′ of AA′.

We have now two scales, AA′ and BB′, divided so that the distance of any point on either, marked we will say 5 from A or B, is proportional to the logarithm of 5.

It is well known that the logarithm of a number added to the logarithm of another number is equal to the log. of the product of these two numbers. Suppose the sliding piece is moved to the left, so that the point marked 2 on the scale BB′ (Fig. 2) is opposite the point marked 1 on the scale AA′. Consider any point on the scale AA′, as α, which is marked 5. The distance of this point from A is proportional to the log. of 5, and its distance from B is equal to its distance from A, together with $B\beta$, a number proportional to the log of 2. Therefore, the distance from B of the point α is proportional to log. 2 + log. 5, that is, to the log. of 10, but this distance is equal to $B\beta'$, and BB is divided proportionally to the logs. of numbers, and therefore the point β' will be marked on the scale BB′, AS.

So that we have $2 \times 5 = 10$,
or log. 2, that is $B\beta$
+ log. 5, that is $A\alpha = B\beta'$, that is log. 10.

In like manner, suppose we have to multiply any number, as 273 by 333. Slide out the scale BB′ so that the number corresponding to 2·73 on this scale is opposite the point A marked 1 on scale AA′, then on scale AA′ look for the point

corresponding to 3·33; below this point on the scale BB′ we find 9·1, the result of multiplying 273 by 333; the decimal point must be supplied afterwards.

Conversely, 910 divided by $333 = 2·73$, and we easily see how to perform a simple division.

Suppose we want to divide 6 by 2.

We know $\log. \frac{6}{2} = \log. 6 - \log. 2$.

Move the point marked 2 on BB′ opposite the point A marked 1 on AA′, look on scale BB′ for the point marked C; above it, on the scale AA′, we find the point marked 3, the result of 6 divided by 2, thus—

$$A\alpha' = B\beta'' - B\beta,$$
$$\text{or } \log. 3 = \log. 6 - \log. 2.$$

The scales CC′, DD′ are divided like the scales AS, SA,′ BS, S′A, only that each division on the scale CC′ is twice as long as the corresponding division on the scales AS, SA′, etc.

We think what has been said is enough to show the principle of the instrument, and that any one who desires to use it will be able, after a few minutes' consideration, to find out for himself how, with the assistance of the sliding piece, QR, a number of successive multiplications and divisions may be performed. This is the course we advise. An empirical rule or two is, however, given,

It will be best to take an example involving all the operations that can arise.

Suppose we wish to find the value of—

$$1·23 \times 4·67 \times \frac{\overline{8·69}|^2}{7·21} \times \frac{4·36}{7·38 \times 2·41} \times \frac{1}{\overline{8·21}|^2}.$$

The number we have to operate on is to be found on the scale AA′; the number with which we operate (that is, with which we multiply, or by which we divide) is to be found on the scale BB′ if it is a simple number, and on the scale CC′ if it is given the square of a number, and the result is read off on the scale AA′.

We first move the notch *a* to the number on which we operate.

Then, if we have to divide, we move the number by which we have to divide to the notch *b*, and then the notch to a point marked 1 on BB′; above the point opposite the notch *a* we read the result. If we have to multiply, we move first a point marked 1 on BB′ to the notch *b*, and then the notch *b* to the number by which we have to multiply. The result is found, as before, above the notch *b* and opposite the notch *a*. Thus, in the case given above, move the notch *a* at once opposite 123 on the scale AA′; we now, as we have to multiply, move BB′ to the right until the point B is opposite the notch *b*, and then move the notch *b* up to the point 467 on BB′; next we have to multiply again, therefore we move the scale BB′ to the left until a point marked 1 is opposite *b*, and then the notch *c* to the point 869 on the scale CC′ (since 869 is squared). Next we have to divide by 721; move 721 on BB′ opposite to *b*, and then *b* to any of the 1 points on BB′; next we have to multiply by 436. Move then the notch *b* to a number 436 on BB′, and then a point marked 1 on BB′ to notch *a*. Next we have to divide by 738. Move 738 on BB′ to notch *b*, and notch *b* afterwards to 1 on BB′. Next we have to divide by 241. Move this number on BB′ to notch *b*, and then *b* to 1 on BB′. Finally, we have to divide by $\overline{821}|^2$. Move this number on scale CC′ to notch *c*, and then notch *b* to 1 on BB′; we now read off the result at *a* on scale AA′, and find it to be 0·204, about. We may also mention that if the notch *a* points to any number on AA′, the notch *d* will point to the square root of that number on DD′; and, conversely, the notch *d* pointing to any number on DD′, the notch *a* will point to its square on AA′.

Arrangements are also made by which we can read on the back of the sliding scale the logs. of numbers, the sines, cosines, tangents of angles, and their reciprocals, the roots of these reciprocals, etc. etc. These numbers, not being generally useful to chemists, are not here entered upon. We may note that one edge, HK, is bevelled off and nicely divided into millimetres; the other edge, FG, is flat and also divided into millimetres.

The whole length of the rule is generally 26 centimetres, and when used simply to measure the length of anything the slide is pulled out if the length exceeds 26 c.m. and the length read off at the bottom of the groove thus disclosed. In conclusion, we may say that the accuracy to be obtained with a rule 25 centimetres long is about 0·3 per cent.

From the great amount of time saved by this instrument we should have expected to find it in use in all laboratories. We hope it will become as common in England as it is in France.

A STIFF EXAMINATION PAPER.

MUCH disapprobation has been expressed at the abstruseness of the questions in Natural Philosophy given in the recent Matriculation Examination of the London University. We ourselves think that most of the questions were far too difficult for Matriculation Students, and are calculated to dishearten future candidates for University degrees. On the other hand, the chemical questions seem to us to have been most judiciously framed.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *July* 8.

Cyclopædias and chemical dictionaries—Liebig's artificial milk—Meeting of the Paris Chemical Society—Isomerism—Brominated camphor—Academy of Sciences—Gaudin's crystallo-chemical system—Forthcoming election—Sale of Fourcroy's minerals.

MY last letter (delayed, but not lost, I hope, although the postal arrangements of France are far from perfection) concluded with announcing to you a new Dictionary of Chemistry. Let us look back today to its predecessors. Cyclopædic literature is very strongly represented in France, and seems particularly suited to the public taste. At present two large universal cyclopædias are announced at the same time. One of them, the 'Dictionnaire Encyclopédique,' by Larousse, is an ordinary mercantile speculation; while the other, published by the chief members of the republican party, promises to be a work of real importance. It is, however, only in the beginning of its career. One thousand shares at £20, issued to cover the expenses of the undertaking, are subscribed mostly by contributors—the editor, M. Laurent Pichat, having himself subscribed for £3000. As far as three hundred years back Vincent Beauvais' 'Speculum Mundi' seems to have given the first impulse to this kind of literature, which, in the latter part of the eighteenth century, attained the culmination of celebrity with the 'Encyclopédie Francaise' of Diderot, D'Alembert, and their friends, who are generally known as the Encyclopædists. Very shortly afterwards (about 1780) commenced the publication of Pankoucke's 'Encyclopédie Méthodique,' extending over a period of more than fifty years, swelling to an immense size and costing as much as 3000 francs. Then followed the 'Encyclopédie du Dix-neuvième Siècle,' the 'Encyclopédie Moderne' of Didot, the 'Dictionnaire de la Conversation et de la Lecture,' and others.

In all these works chemistry played an important part. But this is the first time that a dictionary of pure and applied chemistry only is produced in France.

A dictionary of applied chemistry by Barreswill and Daranne, and a similar work by Barral, published some years ago, are in size and value greatly inferior to most works of the same kind published in England and Germany.

The noise about the non-success of Liebig's artificial milk is increasing. From the Academy of Medicine the subject passed into the medical journals, and thence into the daily newspapers. Leading articles pretend that medical men trying this innocent preparation on infants are committing murder; and most people seem to ignore, not only the quality of the food, but all the numerous and successful experiments made on it in Germany and England. The four children (reported on by M. Depaul) who died were born in the hospital, where the mortality of infants is so great that Liebig's food cannot be accused of being an accessory to the fact.

The CHEMICAL SOCIETY of Paris held its last meeting but one for the season on Friday, the 5th inst.

M. Lecoq de Boisbaudran communicated his researches on crystallisation, already reported upon in the last number of this Journal.

M. Oppenheim gave an account of the continuation of his researches on the isomerism of chloride of allyl and chlorinated propylene. In order to study their chemical differences, he submitted these bodies to the methods used for transforming hydrocarbons into alcohols, pseudo-alcohols, and glycols, so as to decide if one of them, or both, would yield chlorinated compounds of an alcoholic nature. It was found that chloride of allyl could be easily transformed into a body isomeric with chlorinated propylic alcohol, which proved to be identical with the chlorhydrine of propylic glycol. The reagents brought to bear upon the two isomeric chlorides were sulphuric acid, hydriodic acid, bromine, and peroxide of hydrogen. The results obtained proved again the non-identity of the two chlorides.

In the discussion following this communication M. Ladenburg called attention to the rational formula of the chlorhydrine of propylic glycol resulting from the above mode of its formation.

M. Naquet then reported an experiment made by himself and M. Longuinine on monobrominated camphor. It has been impossible to convert this body into a cyanide. Sodium seems to replace bromine in it, thus yielding a product which, by water, is retransformed into camphor. Perchloride of phosphorus transforms it into cymene, C_7H_{14}.

The ACADEMY, at its sitting of July 1st, received several communications, the titles of which may induce readers wrongly to suppose that they treated on chemical subjects.

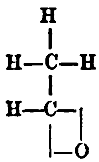
Such is a note of M. Boussinesq *On the reciprocal action of two molecules*, a mathematical paper continuing the researches of Navier, Poisson, and Lauré, on elasticity. Such is, likewise, in spite of its title, a paper by M. Gaudin, *On the part hydrogen plays in acids generally, and in polybasic acids in particular*. M. Gaudin starts from a fundamental idea, which is entirely foreign to chemistry and disproved by facts, viz. that the chemical molecule of a compound is identical with its crystalline molecule. The proof that this view is wrong is furnished by considerations on the water of crystallisation. We know many compounds—in fact, most salts may be given as examples—which are entirely saturated and unable to combine with any other compound or element, but which dissolve in water and crystallise from their solutions together with water. The molecular attraction known as crystallisation and the atomic attraction known as combination are, therefore, functions entirely different from each other, one taking place between the molecules, the other between the atoms of a body. Or if further proof is wanted, let us consider saline molecules which combine with half a molecule of water when crystallising, or, rather, which double when crystallising; thus showing that the molecule in the crystallographic sense and in the chemical are two different things.

The fact alone that elements crystallise as well as combine together, with the admission generally

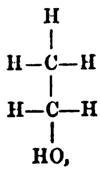
adopted that the chemical molecule of elements consists of two atoms only (with the exception of P, As, Hg, etc.) is sufficient to disprove the idea of M. Gaudin. But M. Gaudin overlooks these facts, and upon his idea of the identity of chemical and crystalline molecules he has founded the doctrine that every molecule, whether crystallised or not, is necessarily constructed in a symmetrical manner. For years he has been occupied in building up models of symmetrical molecules, imitating the crystalline form of certain minerals or salts sometimes of great chemical complication, connecting beads, representing atoms, by means of strings representing the force of symmetry that directs them. He has brought great patience and ingenuity to bear upon this laborious occupation, and it is with real regret that chemists are obliged to repudiate the system which M. Gaudin now lays before the Academy.

His is not a chemical system, not only because it starts from a point of view disproved by chemical facts, but also because it ignores what chemical formulæ are intended to express. Chemical formulæ are to express as many facts as possible; and if we build up what is now generally called formulæ of constitution we construct them with the intention to explain the chemical function of the compound, or the part certain atoms play in the molecule.

If we write aldehyde thus—

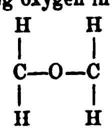


and alcohol thus—



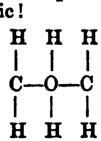
we express the different parts which oxygen plays in these compounds, and the different reactions they will undergo with the same reagents. These formulæ, for instance, show at once that perchloride of phosphorus acting on alcohol, will replace HO by Cl, while with aldehyde it will act so as to replace O by Cl_2.

Nothing of the kind is expressed by M. Gaudin. The looking for symmetry and for symmetry only, must needs place O in the middle both of the alcohol and of the aldehyde molecule, thus giving not only a wrong idea of the nature of these compounds, but making oxygen in alcohol tetratomic!



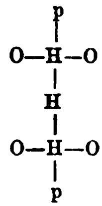
Aldehyde.

and

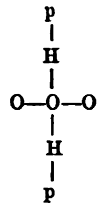


Alcohol.

His formulæ of phosphates show how similar things are represented in a very dissimilar manner. They are as follows, in contradiction with every principle of chemistry.



Tribasic acid, PH_3O_4 ($p = \frac{1}{2}P$)



Bibasic acid, PH_2O_3 ($p = \frac{1}{2}H$).

This is not a chemical system, and it follows as a matter of course that it is in contradiction, not with any particular school, but with every possible school of chemists.

If I have taken up so much valuable space in your paper to give an idea of the contents of M. Gaudin's communication, it is on account of the novelty, and also on account of the publicity given to these ideas. The author has published articles thereon in one of the great political journals of Paris ('Le Siècle'). He has exhibited his models in the Champ de Mars, and has produced photographs and descriptions of the same. A collection of these models, so I am informed, has been sold to one of the university-museums of North America. There is, indeed, some power of seduction in the pretence of representing at the same time the chemical constitution and the crystalline form of a compound, and I thought it the more necessary to show the fallacy of this pretence, as the author, by former researches on the production of high temperatures and on the formation of artificial minerals, has rendered real services to science.

There has also been read at this meeting a paper by M. Béchamp, on the saccharification of the corpuscles contained in diseased silkworms. The production of sugar has been attempted by means of sulphuric acid, and proved (?) by the brown colour imparted to the alcoholic solution of the substance thus produced by adding potassa. The author concludes that the corpuscles contain cellulose.

M. Ch. St. Claire Deville communicates that a volcanic crater had opened on the 2nd of June, after a week of strong earthquakes in St. Michael, one of the Azores. Engineers and captains, wishing to study the phenomenon, have been driven away by the danger attending their purpose.

M. Serret offers the first volume of the works of Lagrange, just published by order of the Ministers of Public Instruction.

From a quarter to 5 until 5 the Academy formed into a secret committee, with the object, it seems, of declaring that a vacancy had occurred in the chemical section by the death of M. Pelouze. These are the preliminaries of a new election. Next Monday, the chemical section will most likely propose a list of candidates, and the election is expected to take place the 14th of July, earlier than has been supposed.

It is said that one candidate only will be unanimously proposed by the section in the first place, that two other chemists will be proposed in the second rank, and a number of younger men will be named in the third rank. The chances of this election may be left to the sagacity of the reader to discuss, and I only mention that two years ago it was unanimously proposed by the chemical section, and accepted by the Academy, to offer the great prize for science to M. Wurtz.

The library and collection of minerals of the deceased chemist, Dr. Ossian Henry, will be sold by auction the 10th and 11th of July. These minerals have some historical interest, having formerly belonged to Fourcroy.*

PARIS UNIVERSAL EXHIBITION.

THE BRITISH COLONIES.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

PARIS; *July* 8.

CANADA.—Rocks and minerals—Metals—Petroleum—Phosphate of lime—Steatite—Magnesian mica—Graphite—Salt—Consolidated turf. NOVA SCOTIA.—Coal—Ores—Bituminous Shale. NEWFOUNDLAND—CAPE OF GOOD HOPE.

AFTER the confusion that reigns in so many other colonies it is quite a treat to examine the collection of rocks and minerals shown in Canada by the Canadian Geological Commission. It would be superfluous to say more in praise of the display than that it fully deserves the gold medal with which it has been rewarded. It has been arranged under the direction of Sir William Logan, and his talented assistant, Dr. Sterry Hunt, and comprehends a series of rocks and fossils, illustrating the geology and palæontology of Canada, and a complete collection of economic minerals. The first half we must dismiss with the remark that the most interesting specimens in the display are some large blocks of the famous Lower Laurentian serpentine, containing numberless examples of the *Eozoön Canadense*. The series of economic minerals commences with some specimens of brown iron ore, which is found in great abundance in the alluvions lying at the foot of the great Laurentian range, and extending over a distance of more than one hundred miles, between Montreal and Quebec, being most abundant in the neighbourhood of the rivers St. Maurice and Batiscan. The St. Maurice smelting furnaces were first established as far back as 1737, and are now in the full tide of prosperity. The ore, which in appearance somewhat resembles our "black brash," is found in a more or less pulverulent condition, almost on the surface of the ground, whence it is collected by the country people of the locality, and sold to the various smelting-furnaces — a somewhat different mode of proceeding to that obtaining in our own iron districts. At some miles' distance from St. Maurice are the Radnor furnaces, which in 1862 turned out 2000 tons of pig iron. The Radnor iron is of a very superior quality, and is greatly used for railway wheels. The samples of red hæmatite shown are very fine; some of them occur in beds no less than thirty feet thick. Several of the specimens are much mixed with chloritic slate and quartz. They sometimes contain notable proportions of titanium. Amongst the magnetic ores shown are several which remind one strongly of some of the Swedish ores, being possessed of the same peculiar coarse, saccharoidal fracture. One of the ores, which is almost pure, is found in beds eighty feet thick, and was formerly sent in large quantities to the United States; but lately successful efforts have been made to smelt it on the spot by the Canada Iron Company. Another valuable ore of great purity is found in successive layers of no less than one hundred feet in thickness, but the furnaces constructed some years since for converting it into pig iron have not been in work for some time. Efforts are now being made once more to work these mines with the idea of sending the ore to the United States, which consumes annually 300,000 tons of a precisely similar ore found on the borders of Lake Superior. A specimen of titaniferous iron sand is also shown. It occurs in considerable quantities at the mouth of the river Moisie, one of the northern tributaries of the St. Lawrence. The Moisie Company exhibit samples of wrought iron and cast steel, made by it from Hodges's process, which consists in mixing peat in a state of paste with the mineral, making bricks of the mixture, and exposing them to the heat of smelting furnaces, a *modus operandi* which produces directly malleable iron of excellent quality. A specimen of titaniferous ore from St. Paul's Bay is also shown. The lead ores do not seem to be of a very high quality, being apparently much contaminated with vein-stuff. As a rule they are not very rich in silver, and contain copper, zinc, and iron, in the state of sulphide. At Indian Cone Gaspé the working of several veins has just commenced, under very favorable circumstances. A small specimen of native copper, from the shores of Lake Superior, is shown. The deposits occur under conditions similar to those on the United States' side of the Lake, but, unlike the latter, they are at present unworked. The Huronian formation is traversed by numerous quartz veins, generally containing copper, in the form of yellow or purple ore. The only places where the mines are worked with anything like regularity are the Bruce and Wellington mines, on the northern shores of Lake Huron. These mines in 1861 produced 3000 tons of ore, containing 19 per cent. of copper, the whole of which was exported to England. Ore of good quality is also found in irregular bunches in the magnesian bands of the Appalachian formation. It is worked in several localities, notably at Leeds and Cleveland. The deposits at the latter place are in the form of true veins, and are worked at the rate of sixty tons per month. The ore, which consists of sulphides mixed with carbonates, contains 10 per cent. of metallic copper. Specimens, mostly of yellow ore,

* I am obliged to correct the following errata in the correspondence of No. 14 of the LAB. In M. Lecoq's note read 15° instead of 190°; in M. Calvert's note read *pieces* not *tubes* of charcoal.

are likewise shown from eleven other mines, all of which are in profitable work. At the Lower Canada mine five shafts, varying from 60 to 132 feet in depth, have been sunk in a length of 1600 feet. The ore appears, in this case, to lie in a kind of basin, and is found in bands of 5 and 10 feet thick. From the number of specimens shown the Appalachian formation in Canada seems to be particularly rich in copper ores, and deserves the attention that capitalists are evidently paying to it. At South Ham are found considerable quantities of antimony, both native and in the form of sulphide and oxide. Good specimens of these are shown, but the deposits do not seem to be worked.

In the catalogue published by the Geological Commission, under the direction of Sir William Logan, it is stated that a specimen of gold from the auriferous alluvions of the valley of the Chaudière is shown, but for some reason or other it does not make its appearance. In the account given of the geology of Canada, in the introduction to the catalogue, gold is said to be found in the alluvions which occur on the south-eastern slopes of the Notre Dame mountains. These alluvions are formed of the *débris* of the Upper Silurian and Devonian rocks, mixed with those of other rocks belonging to the Quebec group, which corresponds with the Llandeilo group of English geologists. The alluvial gold of this district is often accompanied by platinum and osmiridium. The country, however, does not appear to be particularly rich in gold, operations having been hitherto confined to searching for the precious metal in the alluvions mentioned above. In the case of some of these the amount of gold washed out has been very considerable; in others the results have been far from satisfactory. The quartz veins of the locality seem, however, to be comparatively rich, and preparations are being made to carry out the processes of crushing and amalgamation on a large scale. The serpentines of the Quebec group frequently contain chromic iron in irregular layers and bunches, but none of the deposits have yet been worked, although the mineral appears to be very abundant. Four specimens of the ore are shown, but they all seem to be more or less mixed with vein stuff. At Elizabethstown large deposits of iron pyrites are found. The mineral is sent in considerable quantities to the United States, to be used in the manufacture of oil of vitriol. It frequently contains six or seven thousandths of cobalt, which would possibly pay for extraction. Several specimens are exhibited. The magnesian strata of the Quebec group often contain layers of magnesite, generally more or less accompanied by carbonate of iron. In the Bolton district this magnesite forms deposits many yards thick, bounded on one side by a layer of steatite, on the other by serpentine. It is accompanied more or less frequently by green mica, containing chromium and carbonate of nickel. These deposits ought to be valuable as sources of the salts of magnesia.

There are samples of petroleum oil from different parts of the Enniskillen and Gaspé districts. Six of these are from the Lower Devonian formation, one from the Upper, and two from the Lower Silurian. The palæozoic formations of the great western basin of Canada are remarkable for their petroleum deposits, and seem to have their origin in the non-magnesian limestones of the Trenton group of rocks, a series corresponding to the lower members of our Caradoc group, and in the Corniferous formation, which is a limestone, containing nodules of flint, and corresponds to one of the lower limestones of our Devonian system. On examining these rocks, petroleum is found in the cavities contained in them, completely enclosed by the compact calcareous stone, leading one to the inevitable conclusion that either the petroleum itself or the primary matter from which it was formed has occupied its present position since the sedimentary deposit took place. The marls and schists which lie just above the corniferous limestone, and which are known by the name of the Hamilton group, also abound with petroleum. It may be noticed here that the most abundant sources of petroleum exist either in these schists or in the limestones covered by them, and that the quantity is always much less in those places where the schist ore rocks are absent. The schists being penetrated in all directions with fissures, they have served as natural stores for the petroleum, having its origin in the oleiferous limestones below. These fissures are filled with petroleum, water, and marsh gas, and it is the elasticity of this last substance that causes the petroleum to burst forth from the ground with so much violence as soon as these reservoirs are penetrated by the boring tools of the well-sinker. Several instances have occurred in which the penetration of that portion of the rock containing the marsh gas has been followed by the stoppage of all the petroleum springs in the neighbourhood. A notable example of this occurred at Enniskillen, where two springs had yielded some hundreds of gallons daily for many months. A third boring was made in the immediate vicinity, from which issued an immense quantity of gas, causing the instant cessation of the two springs, thenceforth rendering the employment of pumps an absolute necessity. But sooner or later all springs cease to give out the precious oil spontaneously. Pumps are used and the petroleum becomes gradually more and more mixed with water until at last the well is abandoned, and another boring is made, possibly only a few feet from the first, which also gradually becomes exhausted, and is abandoned in its turn. We wish we had space to follow Dr. Sterry Hunt through his very interesting account of the oleiferous strata of Canada, but we must refer our readers to the memoir appended to the catalogue published by the Geological Commission, and which may be had gratis on application to the attendant of the Canadian Court. In certain parts of the Lower Laurentian formation phosphate of lime is found in large quantities. It is pure enough to be employed advantageously in the manufacture of superphosphate for manure, and has consequently attracted the attention of several capitalists, who are beginning to work the deposits. Several specimens of this mineral are shown. Steatite is also being somewhat extensively worked by a company established for the purpose. Some fine specimens of

magnesian mica are also exhibited from North Burgers. The crystals are of great size, one of the laminæ shown measuring nearly 2 feet by 13 inches. It is perfectly transparent, and exhibits the phenomenon of asterism very perfectly. The North Burgers deposits have already been extensively worked.

The Lower Laurentian formation contains numerous deposits of graphite, apparently of excellent quality. It occurs in veins and bunches, and is frequently mixed with carbonate of lime, pyrites, and other minerals. The best qualities closely resemble the well-known Ceylon graphite. Several mines are in full work, and from explorations already made the supply seems practically inexhaustible. Similar mines have been worked at Ticonderoga, in the state of New York. The samples seem pretty pure, but are here and there contaminated with oxide of iron. One specimen, from Petite Maison, is beautifully crystallised.

Canada also produces excellent building stones of various descriptions, marbles and serpentines of great beauty, roofing slates, paving stones, hones —some of which resemble strongly the Llyn Idwal whetstones—gypsum, shelly marl, red and yellow ochre, sulphate of baryta, lithographic stones, white quartz for glass making, and jasper. The lithographic stone is of excellent quality, and the lithographs illustrating Dr. Dawson's memoir on the *Eozoön Canadense* were executed upon it. Salt from a brine spring at Goderich is shown, both as brine and in the crystalline state. The well is nearly 1000 feet deep, and passes through a layer of sal gem 40 feet in thickness. It was discovered in boring for petroleum. The density of the brine is 1·205, and gives on analysis 26 per cent. of chloride of sodium, and about 0·25 per cent. of sulphate of lime and the chlorides of calcium and magnesium. The success which has attended the discovery of this valuable spring has led others to search in the same direction.

A few samples of turf are shown, prepared by Mr. Hodges's process. It consists in cutting a navigable canal through the marshes by means of a boat of peculiar construction, which not only cuts its own way through the turf, but collects what it has cut, grinds it to paste, and spreads it out in a thin layer on the side of the canal to dry. This apparatus, with the help of six men, can thus treat 1500 cubic yards of turf in a day. This process has been at work for several months, and the consolidated turf made by it is used by the locomotives on the Grand Trunk of Canada Railway with the greatest success. It is hardly possible to exaggerate the value of this process, seeing that Canada is destitute of coal, although possessed of other mineral resources in no insignificant quantity. The consolidated turf can be prepared at the rate of 5d. per metric quintal (100 kilogrammes).

It is really with reluctance that we part from this very beautiful collection, so much is there to admire in it, both with regard to the specimens shown and the manner in which they are exhibited. In both respects it reflects the highest credit on Sir William Logan and his assistants, Dr. Sterry Hunt and Messrs. Murray and Billings. Great Britain may truly learn a valuable lesson by observing the manner in which her children, Victoria and Canada, have exhibited their mineral treasures.

In Class 40 Canada only exhibits a few specimens of potash and pearlash, and some colours.

Passing by the Bahamas, Barbadoes, Mauritius, Malta, St. Vincent, and British Guiana, we come to Nova Scotia. The great mineral product of this colony appears to be coal, of which there are six exhibitors. The specimens are shown close by the British Lighthouse. One of them is from a seam over thirty-six feet in thickness. The gold specimens are but few, and offer but little matter for examination. Dr. Honeyman shows a fine collection of minerals, with several maps and sections of the country. Mr. How also shows a large series. Manganese seems rather a plentiful mineral in the colony, there being several exhibitors of it. The Acadia Charcoal Iron Company show several specimens of iron ores, which seem to be mostly brown hæmatite. Messrs. W. Barnes and J. B. Oxley also exhibit specimens of the same ore. Mr. Jackson shows bituminous shale, with shale oils distilled from it. It is of rather rich quality, yielding 120 gallons of crude oil to the ton. A collection of silicious minerals is shown by Mrs. Webster, whom we should not be ungallant enough to scold for destroying their interest by omitting to append to them their names and localities.

In Newfoundland we have a series of minerals shown by the Geological Survey, but as no detailed account of them is given they might almost as well have been left amongst the codfish and dogs of their native land. A few specimens of galena, copper pyrites, granite, and marble, are also shown, but there is nothing about them to call for remark. They are mixed up in the most unaccountable way with the collection exhibited by the Geological Survey.

The Cape of Good Hope makes but a poor show. There are a few specimens of copper ores, shown by the Cape Copper Mining Company, and a sample of manganese by Mr. Auret. In Class 44 there is some carbonate of potash, extracted from "*suint*," and a sample of rough tartar.

UNIVERSITY COLLEGE.

At a Session of the Council of University College, London, on Saturday, the 6th of July, Dr. J. Russell Reynolds was appointed Professor of the Principles and Practice of Medicine. The Holme Professorship of Clinical Medicine was declared vacant by the resignation of Dr. Reynolds, and the vacancy was ordered to be advertised. On the report of the Faculty of Arts and Laws, the Jews' Commemoration scholarship, of £15 per annum for two years, was awarded to Mr. E. Seymour Thompson, of Bridgewater. The following gentlemen, graduates in medicine of the University of London, were appointed Fellows of the College:—Dr. W. Tilbury Fox; Professor Wilson Fox, M.D.; Professor Graily Hewitt, M.D.; Dr. Henry Maudsley; and Professor Ringer, M.D. The following gentlemen, graduates in Arts and Laws of the University of London, were also appointed Fellows of the College:—M. N. Adler, M.A.; Jonas Ashton, M.A.; L. M. Aspland, M.A., LL.B.; Talfourd Ely, M.A.; Professor G. C. Foster, B.A.; Michael Foster, B.A., M.D.; W. Brittain Jones, B.A.; James E. Odgers, M.A.; Theodore Waterhouse, LL.B.; and Alexander Waugh Young, B.A.

THE METROPOLITAN WATERS IN JUNE.

Report on the Waters supplied to the Metropolis during the month of June, 1867, presented to the Registrar-General by E. FRANKLAND, *F.R.S., Professor of Chemistry in the Government School of Mines.*

1. Companies.	2. Date and Place of Collection.	3. Total solid impurity in 100,000 parts.	4. Organic Carbon.	5. Nitrogen, as Nitrates and Nitrites.	6. Ammonia.	7. Total combined Nitrogen.	8. Previous Sewage Contamination. (Estimated.)	9. Total Hardness.
Thames.								
Chelsea	1st June, Cab Rank, Horse Guards	28·28	·261	·214	·004	·217	1158	20·3
West Middlesex	1st June, Great Portland Street, W.	27·22	1·020	·218	·120	·421	2195	19·4
Southwark & Vauxhall...	14th June, Barclay's Brewery	29·70	·231	·170	·002	·172	735	20·9
Grand Junction	24th June, Roy. Coll. Chem.	28·42	·265	·204	·004	·207	1085	20·9
Lambeth......	3rd June, Cab Rank, Westminster Rd.	28·18	·325	·220	·001	·229	1305	20·9
Other Sources.								
New River...	1st June, Haverstock Hill	23·12	·217	·198	·001	·199	1005	16·3
Ditto, filtered thro' animal Charcoal ...	Ditto	21·02	·071	·156	·004	·159	605	12·3
East London	21st June, Old Ford Waterworks	27·22	·237	·150	·002	·152	535	19·7
Kent	13th June, Waterworks, Deptford	39·04	·165	·320	·001	·321	2225	28·3
Loch Katrine	February 7th, Glasgow	3·28	·256	·031	·002	·041	0	0·3

For the purpose of comparison I append also the results yielded by Loch Katrine water, as supplied to Glasgow, when submitted to the same analytical processes.

The numbers in columns 3, 4, 5, 6, 7, 8, and 9, all relate to 100·000 parts of the waters. The Table is to be read thus:—100·000 lb. of Chelsea water collected on 1st June at the Horse Guards cab rank contained 28·28 lb. of solid impurity; the organic matter, constituting a portion of this impurity, contained ·261 lb. of carbon. This solid impurity also contained ·214 lb. of nitrogen in the form of nitrates and nitrites, besides ·004 lb. of ammonia, whilst the total amount of *combined* nitrogen in every form was ·217 lb. The above quantity of water supplied by the Chelsea Company had been, after its descent to the earth as rain, contaminated with sewage or manure matter equivalent to 1158 lb. of average filtered London sewage. By gradual oxidation, partly in the pores of the soil, partly in the Thames or its tributaries, and partly in the reservoirs, filters, and conduits of the Company, this sewage contamination had been entirely converted into comparatively innocuous inorganic compounds before its delivery to consumers. Finally, 100,000 lb. of the Chelsea Company's water contained 20·3 lb. of carbonate of lime, or an equivalent quantity of other soap-destroying ingredients.

The above analytical results show that the water of the West Middlesex Company, drawn from the stand-pipe at the cab-rank in Portland Road on the 1st inst. was contaminated with sewage (*present* sewage contamination); for, if the amount of nitrogen existing as nitrates, nitrites, and ammonia (·318 part) be deducted from the total combined nitrogen, there remains ·103 part, which must be *organic* nitrogen, equivalent to 1030 parts of average London sewage in 100,000 parts of the water, or rather more than one per cent. The water was turbid when drawn, and after standing for a few days emitted a very offensive odour, and became filled with white flocculent matter resembling that which gradually deposits from filtered sewage. A few days later this odour disappeared. In answer to my inquiries the engineer of the Company informs me that a breakage had occurred in one of the Company's mains in an adjoining street, and near a gully hole. This fracture, which was repaired on the 3rd of June, soon after its discovery, happened to a main from which the water pressure was removed at night, and it is believed that, during this absence of pressure, sewage commingled with the contents of the main. It is gratifying to find this satisfactory reason for believing that the contaminated water was delivered to a small district only, and for a short time; but the accident supplies another item to the already long list of dangers attending an intermittent supply of water. On the *constant* system no sewage contamination arising from such a cause could occur. On taking a sample from the same source on the 7th inst. I found the water restored to the usual condition of normal Thames water.

The water of the Southwark Company was turbid when drawn from the main; and that of the East London Company very slightly so.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

On a New Class of Ureas. By A. Wurtz.

In describing the action of amylenic iodhydrate on argentic cyanate, the author has spoken of an amylenic cyanate, $(C_5H_{10}H)'CyO$, as isomeric with amylic cyanate, $(C_5H_{11})CyO$. This view is confirmed by the following experiments:

Amylic cyanate, by fixing the elements of ammonia, gives rise to amyl-urea; and amylenic cyanate, in like manner, yields a urea isomeric with amyl-urea. The homologues of amylenic cyanate may also be expected to form with ammonia ureas isomeric with those described by the author eighteen years ago. Between these new bodies and the ureas properly so called there doubtless exists the same relation as between the pseudo-alcohols and the normal alcohols, and the isomerism existing between all these several products admits of the same interpretation. Amylene, in fact, maintains in the pseudo-alcohol, and all its allied products, a certain individuality, as indicated by the following formulæ:

$$\left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}O \qquad \left.\begin{matrix}(C_5H_{10}H)'\\H\end{matrix}\right\}O$$

Amylic alcohol. Pseudo-amylic alcohol.

$$\left.\begin{matrix}(CO)''\\(C_5H_{11})H\\H_2\end{matrix}\right\}N_2 \qquad \left.\begin{matrix}(CO)''\\(C_5H_{10}H)H\\H_2\end{matrix}\right\}N_2.$$

Amyl-urea. Amylenic pseudo-urea.

To obtain the pseudo-urea, amylenic cyanate is first prepared by mixing argentic cyanate with amylenic iodhydrate at a very low temperature, then warming the mixture, distilling, and collecting the distillate in well-cooled receivers. The amylenic cyanate thus obtained, which has a very irritating odour, is then shaken up with excess of aqueous ammonia, the mixture, in the course of a day, solidifying to a mass consisting of the new urea, which may be purified by crystallisation from boiling water.

Amylenic pseudo-urea crystallises in splendid needles, which melt at about 151°. It partly volatilises, yielding a crystalline sublimate, but at the same time an ammoniacal odour becomes perceptible, indicating a partial decomposition. It dissolves easily in alcohol, and 1 part of it dissolves in 79·3 parts of water at 27°. Heated in sealed tubes with a strong solution of caustic potash, it splits up at 140°—150° into carbonic dioxide, ammonia, and an alkaloid isomeric with amylamine.

The crystals of the pseudo-urea, moistened with nitric acid, yield an oily liquid, which deposits on evaporation crystals of ordinary nitrate of urea.

Ordinary amyl-urea differs strikingly from its isomer, crystallising in white laminæ, and being three times as soluble in water as the latter.

Amylenic cyanate does not split up under the influence of caustic potash into carbonic dioxide and amylamine, like its isomer, but is converted into a diamylenic pseudo-urea:

$$2[CN(C_5H_{10}, H)O] + 2KHO = \left.\begin{matrix}(CO)''\\(C_5H_{10}, H)_2\\H_2\end{matrix}\right\}N_2 + K_2CO_3.$$

This urea sublimes in fine needles in the sealed flasks in which the operation is conducted. It is nearly soluble in water. Potash does not attack it at the temperature of boiling oil.

Amylenic cyanate in contact with water splits up into carbonic dioxide, and a urea having the composition of the preceding.

On a New Class of Compound Ammonias. By A. Wurtz.*

Isamylamine, the base mentioned in the preceding note, as produced from amylenic pseudo-urea under the influence of caustic alkali, is prepared by enclosing the pseudo-urea in flasks of very refractory glass with a strong solution of caustic potash and a few lumps of the solid hydrate, and heating the vessel for several days in an oil-bath to 150°, till the crystals of the pseudo-urea disappear completely, and are replaced by a mobile oil. This liquid, decanted after cooling, and distilled over caustic baryta, first gives off ammonia, and then isamylamine, the baryta being left dry at 90°.

Isamylamine, when purified by rectification, boils at 78·5° (corrected), and has a density of 0·755 at 0° (amylamine boils at 95°, and has a density of 0·815 at 0°.) Like amylamine, it has a very decided ammoniacal odour. It mixes with water in all proportions, producing a very perceptible disengagement of heat. The solution precipitates metallic salts, but does not redissolve cupric hydrate.

When the vapour of isamylamine is strongly heated in contact with caustic baryta, the latter suddenly becomes incandescent. When, however, the vapour is quickly passed over baryta strongly heated in a glass tube, no incandescence takes place, but the volatile base is partially decomposed, giving off a small quantity of combustible gas, and forming a small quantity of barium-cyanate. The base is not decomposed by prolonged exposure to a temperature of 200°.

Bromisamylamine, $C_5H_{12}BrN$.—A strong aqueous solution of isamylamine shaken up with bromine, the base being in excess, forms an orange-yellow liquid, which, when distilled, yields bromisamylamine in the form of a heavy, dark yellow liquid. When heated it is decomposed, with tumefaction and carbonisation. The alkaline liquid from which this body has separated contains bromhydrate of isamylamine.

Chlorhydrate of Isamylamine, $C_5H_{13}N.HCl$, is precipitated in crystalline scales on adding ether to a very concentrated solution of the salt in absolute alcohol; and if the ether be poured on to the top of the alcoholic liquid, so as to form a separate layer, the chlorhydrate is deposited at the surface of separation of the two liquids in fine square-based octo-

* 'Bull. Soc. Chim.' [2], vii, 143.

hedrons. The crystals have a strong lustre, effloresce on exposure to the air, dissolve very freely in water and in alcohol.

The *chloroplatinate*, $2(C_5H_{13}N.HCl)PtCl_4$ is very soluble in water and in alcohol, and differs from the corresponding amylamine-salt by not being precipitated immediately on adding platinic chloride to a concentrated solution of the chlorhydrate. From a strong aqueous solution it is deposited by spontaneous evaporation, in fine red crystals belonging to the monoclinic system.

The *chloro-aurate*, $C_5H_{13}N.HCl,AuCl_3$, is deposited from aqueous solution in bulky yellow crystals, also monoclinic.

The preceding observations leave no doubt as to the isomerism of amylamine and isamylamine. It would be easy to increase the number of these isomers by converting the iodhydrates of butylene, hexylene, caprylene, etc., into ureas and amines. The explanation of this isomerism is perfectly easy, the relations existing between amylamine and isamylamine being, in fact, the same as that between amylic alcohol and amylenic hydrate; thus—

$C_5H_{10}, H(OH)$ Amylenic hydrate.	$C_5H_{10}.H(NH_2)$ Isamylamine.
$C_5H_{11}, (OH)$ Amylic hydrate.	$C_5H_{11}(NH_2)$ Amylamine.

But if this be the case, how is it that isamylamine does not exhibit any tendency to split up into amylene and ammonia, whereas amylenic hydrate decomposes so readily into amylene and water? The difference is due to the force with which the nitrogen is retained by the carbon. This will be better understood by developing the formulæ as follows:

CH_3	$CH_2.H$	CH_3	$CH_2.H$
|	|	|	|
CH_2	CH_2	CH_2	CH_2
|	|	|	|
CH_2	CH_2	CH_2	CH_2
|	|	|	|
CH_2	CH_2	CH_2	CH_2
|	|	|	|
$CH_2(OH)$	$CH_2(OH)$	$CH_2(NH_2)$	$CH_2(NH_2)$.*
Amylic hydrate.	Amylenic hydrate.	Amylamine.	Isamylamine.

In hydrate of amylene, the hydroxyl OH, being less strongly attached than in hydrate of amyl, more easily abstracts the third hydrogen-atom of $CH_2.H$, which is less strongly united to the carbon than the third hydrogen-atom of CH_3.

In isamylamine the group NH_2, although less strongly attached to the carbon by the nitrogen than in amylamine, is, nevertheless, incapable of abstracting the third hydrogen-atom of $CH_2.H$, in consequence of the preponderating affinity of the carbon for the nitrogen. This affinity shows itself in the formation of barium-cyanide by the action of baryta and isamylamine.

These considerations, if correct, afford a new example of the utility of the theory of atomicity in the interpretation of isomerism.

* Amylene is sometimes regarded as $(CH_2)_5$, an hypothesis which can scarcely be admitted without further discussion. The explanation of the isomerism above considered is, however, independent of it.

On the Presence of Sarkolactic Acid in the Urine. *By* Otto Schultzen.*

The urine of men or animals which have been poisoned with phosphorus always contains large quantities of sarkolactic acid, sometimes as much as 10 grammes or more. The method of obtaining the acid is as follows. The urine is evaporated to a syrupy consistence in the water-bath, heated with strong spirit, and left in contact with the latter for twenty-four hours. The clear, dark-brown alcoholic extract is then evaporated, sufficient sulphuric acid added, and the whole well shaken with ether, which solvent, on distillation, leaves a residue of the impure acid. The educt is dissolved in water, mixed with a few drops of poly-plumbic acetate, filtered, treated with hydric sulphide, and again evaporated. The substance that remains behind was shown to be sarkolactic acid by the crystalline form, solubility, and quantitative composition of its zinc, cupric and calcic derivatives.

VARIA.

Mr. Thomas Parkins, of the Robert Town Chemical Works, has written to us to complain that he has received no award for his acknowledged fine specimen of yellow prussiate of potash, exhibited in the British Department of the Paris Exhibition. He states that the Jurors did not examine the contents of his case.

By a report from the Select Committee on East London Water Bills that has just appeared, it is found that the present average daily supply of water to the inhabitants of London amounts to 78,408,619 gallons, that the present population (at the very fair average of twenty gallons per head) should consume 61,294,760 gallons, and that hence there is a probable daily waste of 17,103,859 gallons.

The Dundee Meeting of the British Association for the Advancement of Science (thirty-seventh meeting) will be opened on Wednesday, the 4th of September, 1867. The Duke of Buccleuch will preside, with the following list of vice-presidents:—The Earl of Airlie, Lord Kinnaird, Sir John Ogilvy, Bart., M.P., Sir David Baxter, Bart, Sir R. I. Murchison, Bart., Sir David Brewster, James D. Forbes, LL.D. The Local Secretaries are J. Henderson, Esq., J. A. L. Gloag, Esq., P. Anderson, Esq., 21, Reform Street, Dundee.

Some weeks ago we called attention to a few of the glaring errors and absurdities contained in a little book of Chemical Notes, specially arranged for the London University Matriculation Pass. Although a scientific contemporary had likened this production to a deservedly popular text-book on Mechanical Philosophy, we failed to detect in it anything that would save it from that receptacle of pseudo-scientific literature, the twopenny box of the book-stall. Whether our remarks on the work have affected its sale we cannot say, but it appears that its publishers have taken exceptional means for promoting its circulation. We are informed that during the recent matriculation examination of the London University, copies of the book might be purchased in the courtyard of Burlington House, on the very threshold, in fact, of the examination-room.

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journäle und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

* 'Zeit. Chem.' (1867), 138.

THE

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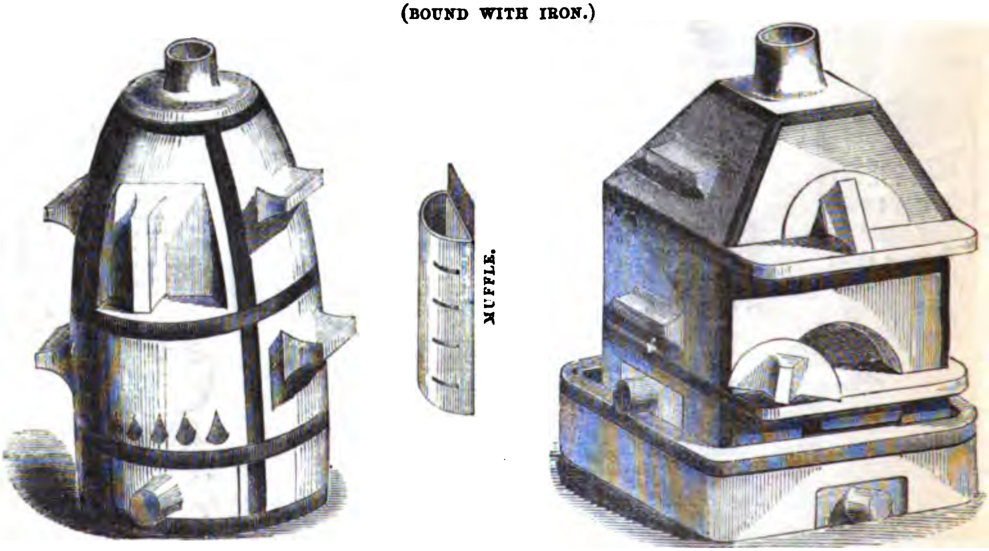

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1867, Dec. 9.

THE LABORATORY:

A Weekly Record of Scientific Research.

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CONTENTS.

TO THE

MEMBERS

OF THE

UNIVERSITY OF LONDON.

LONDON; *July*, 1867.

GENTLEMEN,—We beg leave to place before you the name of Sir JOHN LUBBOCK, Bart., F.R.S., as that of a gentleman eminently fitted to represent the University of London in Parliament.

The University of London is publicly recognised as embodying certain distinct principles; and it is obviously incumbent upon us to choose as our Representative a man whose known opinions are a guarantee that he will uphold those principles, and who also possesses sufficient ability and influence to aid materially in their advancement.

The main function of our University being to promote liberal and scientific education apart from all consideration of religious questions and other restricting influences, its political action must, as a necessary consequence, be particularly directed to the removal of all civil disabilities incurred on account of religious belief, to the vigorous development of national education on a broad basis, and to the active encouragement of science as an important element of general culture and an essential condition of national prosperity.

Sir JOHN LUBBOCK takes the warmest interest in all these objects, and would bring to the furtherance of them in the House of Commons the same zeal and energy which he is well known to have devoted to them without its walls. He moreover possesses unusual qualifications for their successful advocacy; for, while his intellectual and scientific eminence would give weight to his words on questions of science, of education, and of civil polity, his position in the City of London and his reputation as a man of business would obtain for him a hearing that might be denied to any one more exclusively occupied in scientific pursuits. For the same reasons he is peculiarly fitted to be the spokesman in the House of Commons of the large and increasing body of scientific men—a class whose opinions have hitherto found very inadequate expression in Parliament. This position, it need hardly be said, the public would naturally look to the representative of the University of London to occupy; and we have conclusive evidence that it would be difficult to find any one who would fill it so completely to the satisfaction of the leading scientific men of the country as Sir JOHN LUBBOCK.

The claims and wishes of the medical profession, with which our University is so closely and honorably connected, he fully appreciates and understands (indeed, so eminent a cultivator of Biological Science could hardly do otherwise), and he would be able to press them upon the attention of the country unhampered by the disadvantage of being regarded as a professional advocate.

On all general political questions he is well known to be an earnest and thorough Liberal, and, at the last general election, he obtained the hearty support of the whole Liberal party in West Kent.

Although Sir JOHN LUBBOCK is not a Graduate of our University (or of any other), he is closely identified with it, both by his own position as a Member of the Senate, and by the fact of his father having been one of the original Fellows and the first Vice-Chancellor.

G. CAREY FOSTER, B.A.,
WM. ODLING, M.B., F.R.S.,
On behalf of the Provisional Committee.

THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science.

Contributors.

F. S. Barff, M.A. Cantab., F.C.S.
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Father Secchi, Director of the Observatory at Rome.
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J. A. Wanklyn, Professor of Chemistry at the London Institution.
Henry Watts, B.A., F.R.S., Editor of the new 'Dict. of Chemistry,' &c.
W. M. Watts, D.Sc., Principal Assistant in the University Laboratory, Glasgow.
C. Greville Williams, F.R.S.
Adolphe Wurtz, Paris.

Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzo-salicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *On Chlorophyll*, by Mr. Tichborne; *On a New Form of Sand Battery*, by Father Secchi; *On Brodie's Chemical Symbols*, by Mr. W. S. Jevons; *On a Method of Determining Vapour-Densities*, by Dr. Watts; *On London Waters*, by Prof. Wanklyn; *Calculus of Chemical Operations*, by Sir B. C. Brodie; *On Affinity and Electricity*, by Georges Salet; *Geber*, an Historical Study.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise Editorial Articles, Critical Reviews of Books, practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

UNIVERSITY OF LONDON.

FIRST B.SC., AND PRELIMINARY SCIENTIFIC M.B. PASS EXAMINATIONS.—1867.

***Monday*, *July* 15.—*Morning*, 10 *to* 1.**

CHEMISTRY.

Examiners.—Henry Debus, Esq. Ph.D., F.R.S., and Prof. A. W. Williamson, Ph.D, F.R.S.

1. How would you obtain water, carbonic acid, oxygen, and nitrogen, respectively, from atmospheric air?

2. Describe how you would prove that water is formed when hydrogen is burned in oxygen. How much water can be obtained from one pound of hydrogen? How do you explain the action of platinum on a mixture of hydrogen and oxygen?

3. Describe how sulphur may be obtained in its different allotropic modifications, and also the leading properties of each modification. Why is sulphur said to be dimorphous? How many volumes of sulphurous acid can be obtained from two volumes of oxygen?

4. Describe the preparation of ammonia, and explain your process by means of symbols. Represent by equations the action of ammonia on aqueous solutions of the following substances:—(*a*) Hydrochloric acid; (*b*) Ferric chloride; (*c*) sulphuric acid; (*d*) calcic chloride; (*e*) plumbic nitrate; and (*f*) cupric chloride.

5. Neither pure nitric acid nor pure hydrochloric acid is able to dissolve gold; but a mixture of the two acids will dissolve the metal. Explain how aqua regia produces this effect, and describe the chemical constitution of this substance.

6. How is phosphoric acid prepared from bone-ashes? and how would you distinguish this acid from arsenic acid? Describe fully the effect produced by heat on the following phosphates:—

Na_3PO_4, Na_2HPO_4, and NaH_2PO_4.

***Monday*, *July* 15.—*Afternoon*, 3 *to* 6.**

CHEMISTRY.

Examiners:—Henry Debus, Esq., Ph.D., F.R.S., and Prof. A. W. Williamson, Ph.D., F.R.S.

1. Arrange the metals in groups according to their behaviour with water at different temperatures.

2. How would you crystallise bismuth? What are the crystalline forms of bismuth, antimony, copper, gold, and potassium? What is the composition of brass, bronze, gun-metal, bell-metal, and type-metal?

3. Describe the preparation of potassium from potassic carbonate. What products are formed when water, moist air, chloric and hydrochloric acid, respectively, act on potassium? Give an outline of the chemical character of each of these products.

4. A piece of potassium and a piece of sodium are given. How would you distinguish the two metals from each other?

5. Describe the chemical differences between the so-called alkalies and alkaline earths. In what respect does arragonite differ from Iceland spar? Describe the leading properties and the preparation of calcic oxide. Explain the formation of stalactites.

6. How would you prepare zinc sulphate? Give the formula of this body, and name salts with which it is isomorphous.

7. How much dry hydrochloric acid is required for the precipitation of one pound of argentine nitrate ($AgNO_3$)?

ORIGINAL COMMUNICATIONS.

TECHNICAL ANALYSIS.

Preparation of Standard Solutions of Sulphuric Acid and Ammonia. By ROBERT GALLOWAY, *F.C.S.*, *Professor of Practical Chemistry, Museum of Irish Industry.*

IN collecting materials for a work on technical analysis, I have been led to determine the specific gravity of a solution of sulphuric acid (HO, SO_3) containing an equivalent of the acid in 1000 gr., and the specific gravity of a solution of ammonia (NH_3) containing an equivalent of that substance in 1000 gr. of the solution, *at different temperatures*, in order that standard solutions of these substances may be more readily prepared than is possible by the plans generally given. The following are the results:

Sulphuric acid solution, containing an equivalent of the acid in 1000 *fluid grains; temperature of the solution,* 60° *F.*

Specific Gravity.	Fahr.
1032·5	55°
1032·	60°
1031·3	65°
1030·6	70°
1029·8	75°
1028·9	80°

1000 measures of this acid solution increases in bulk when the temperature is raised from 60° F. to 80° F., to 1005 measures.

Ammonia solution, containing an equivalent of NH_3 *in* 1000 *fluid grains of the liquid; temperature of the solution,* 60° *F.*

Specific Gravity.	Fahr.
992·8	55°·4
992·3	60°·8
992·	65°
991·6	69°·8

To prepare the solutions, introduce a delicate hydrometer and thermometer into any quantity of distilled water, then add the acid or ammonia, as the case may be, until the correct specific gravity for the temperature is nearly reached; then allow time for the complete mixing of the liquids; and finally add water, or acid, or alkali, until the solution is of the proper specific gravity.

THE WATER SUPPLY.

The Thames Water at Hampton Court. By J. A. Wanklyn, E. T. Chapman, *and* M. H. Smith.

On the 9th of this month we went to Hampton Court and took samples of the Thames water, a little above and a little below that spot. Both samples were taken from the middle of the stream, the one above the weir and just above the place where three water companies draw their supply from the river, and the other lower down than the weir and below Hampton Court. The water was examined within twenty-four hours of its being collected, and with the following results:

Thames near Hampton Court.

Source.	*Parts in* 1,000,000. Ammonia as such, and as Urea.	Ammonia from Albuminoid Matter.
Water taken above the weir, Unfiltered	0·045	0·280
Same, Filtered.................	0·045	0·210
Water taken below the weir, Unfiltered	0·015	0·230
Same, Filtered.................	0·015	0·185

This table shows two interesting facts, namely, (1) That filtration removes some of the albuminoid matter. Inasmuch as the London supply of Thames water is drawn off near the spots at which the two samples were taken, and inasmuch as it is provided by law, that the water companies shall filter their water, we ought to find the water taken from the mains in London, *at least equal* in purity to the filtered water of this table. (2) That the effect of passing over the weir, and running for about two miles, is to purify the water, disposing of two thirds of the free ammonia, and of about one sixth of the albuminoid matter. We will not undertake to say whether oxidation or plant life causes the diminution of the ammonia.

The points at which we took our samples were about two miles apart, and between them the Thames receives on the right a small river, the Mole, and on the left a small stream called the New River.

The water of the Mole was also taken on July the 9th, and examined the day after.

The River Mole.

Source.	*Parts in* 1,000,000. Ammonia as such, and as Urea.	Ammonia from Albuminoid Matter.
Water taken at junction with the Thames, Unfiltered ...	0·015	0·250
Same, Filtered.................	0·015	0·150
Half a mile higher up the stream, Unfiltered	0·015	0·240
Same, Filtered.................	0·015	0·180

This table shows that the Mole, considered as to its free ammonia and albuminoid matter, is very like the Thames at Hampton Court. The effect of filtration on this water is even more marked than in the case of the Thames just cited.

The New River (Hampton Court).

Source.	*Parts in* 1,000,000. Ammonia as such, and as Urea.	Ammonia from Albuminoid Matter.
Water taken about a mile from Hampton - Court, Filtered	0·105	0·240
Water just as it falls into the Thames, upper exit, Filtered	0·090	0·250

This water was collected on July 9th, kept in a cool place, and examined on July 11th.

Compared with the Thames, the volumes of the Mole and New River are small, so that no appreciable effect on the composition of the water of the main stream is produced by these tributaries.

An examination of the Thames above Windsor still shows the presence of a considerable quantity of albuminoid matter.

Source.	*Parts in* 1,000,000 Ammonia as such, and as Urea.	Ammonia from Albuminoid Matter.
Water from Cookham bridge, Filtered	0·015	0·150
Water from Wycombe brook, about 1½ mile from its junction with Thames near Cookham, Filtered	0·075	0·190

These samples were taken on July 7th, and examined next day.

It will be observed that the albuminoid ammonia in the different waters given in this paper, ranges from 0·28 to 0·15 per 1,000,000. Except in distilled water and in certain spring waters, we have not yet met with less than 0·05.

London Institution.

Removal of Nitrogenous Organic Matter from Water by Clark's Process. By E. T. Chapman.

In the reports to the Board of Health on the condition of the water companies* the inspectors appointed by that body discuss the proposal to apply Clark's process to the water supplied to London. They state that the process is in active operation at the Plumstead waterworks, and that the chalk obtained as a waste product in the operation, when applied to well-waters or waters without organic matter, is so valuable that it pays a large proportion of the working expenses. They go on

* Reports on the Metropolis Water-supply, 1856.

to say that of course this advantage cannot be obtained with Thames water, the chalk obtained from which is contaminated *with organic matter and is valueless.* On reading this I naturally made a note to the effect, "Clark's process removes organic matter from water as well as softens it, and it is therefore of the utmost importance that it should be applied to the London waters." It appears, moreover, that Dr. Clark himself contemplated such purification of water by the application of his process, but the analytical methods of his time were incapable of showing to what extent improvement was effected.

This view of the case is fully borne out by experiment. I find that from one half to two thirds of the nitrogenous organic matter contained in a hard water after filtration is removed when the water is subjected to Clark's process. Further, I find that the chalk contains the organic matter taken from the water. The following experiment made on New River water will serve to prove this.

Four litres of this water were submitted to Clark's process; a sample of the unaltered water was at the same time collected. These samples were placed side by side, and allowed to stand all night. Next morning portions of both samples were submitted to our process for the direct estimation of the nitrogenous organic matter. The results were:—

	Before Clark's Process.	After Clark's Process.
	Parts in the 1,000,000.	
Free Ammonia	0·01	0·01
Ammonia from Organic Matter	0·05	0·02

The chalk from the four litres which had been submitted to Clark's process was diffused through distilled water, and the same estimation made upon it; it yielded ·09 milligrammes of ammonia. Dividing this number by 4, we obtain ·0225, *i. e.* the amount per 1,000,000 parts, which is nearly the amount lost by the water. This leaves but a small proportion unaccounted for, and, considering the smallness of the quantities, is as good an agreement as could be wished.

Another experiment was made on a sample of Thames water taken at Hampton Court. The values for ammonia, and ammonia from nitrogenous organic matter, are annexed, both before and after filtration, through filter-paper, and also after the *unfiltered* water had been subjected to Clark's process.

	Before Filtration.	After Filtration.	After Clark's Process, Unfiltered.
Free Ammonia...........	0·025	0·025	0·030
Ammonia from Organic Matter	0·26	0·22	0·08

In this case, therefore, I had effected a reduction of 69·3 per cent. on the unfiltered water, and 63·64 per cent. on the filtered.

The next example is a water of very similar composition, but it was filtered before applying Clark's process:

	Filtered Water before Clark's Process.	Filtered Water after Clark's Process.
Free Ammonia	0·015	0·020
Ammonia from Organic Matter	0·22	0·07

Here there is a reduction of 68·2 per cent.

The next example is a water from a chalk well known to be contaminated with organic matter. The water was quite clear and was not filtered.

	Before Clark's Process.	After Clark's Process.
Free Ammonia, and Ammonia from Urea	0·195	0·15
Ammonia from Organic Matter	0·12	0·06

In this instance the reduction was 50 per cent.

The nature of the organic matter removed from the water does not appear to be identical with that which remains; for, while the latter is very easily broken up and made to yield its ammonia, the former requires prolonged boiling with potash and permanganate.

I conclude that everything which can be removed by the most careful filtration (excepting always such larger particles as can be removed by straining through a cloth) can also be removed by Clark's process.

The difference in appearance of the water before and after Clark's process was very marked in the second and third examples, the colour having changed from brownish-green to a peculiar bluish-green.

If I am right, therefore, it is of the utmost importance that Clark's process should be carried out on the London water supply, as by it we should not only obtain soft water, but also water freed, to a great extent, from organic matter. Were the process adopted we might dispense with the elaborate filtration now employed, substituting for it a simple straining; the Clark process itself would, I have little doubt, yield just as good a water when applied to the strained water as to the filtered.*

The Clark process is applicable to sewage; at any rate, when lime water is added to sewage a precipitate is at once obtained, and this precipitate is highly charged with organic matter. Would not this precipitate be a most valuable manure, and would not the water

* All the water supplied to London by the Thames Companies, which we have yet examined, contain nitrogenous organic matter in larger quantity than the sample of New River water mentioned above.

decanted from it be freed, to a great extent, from its noxious properties? I hope to return to this subject at a future date, and to bring more exact experimental data to bear upon it.

London Institution.

The Water of Bala Lake. *By* R. H. Smith, *F.C.S.*

As it has been proposed to supply London with water from Bala lake, it appeared to me that an analysis of the water of the lake would be of public interest.

The sample was collected early on Monday morning (July 15) and examined on Wednesday morning, with the following results:

Parts in the 1,000,000.
(i.e. milligrammes in a litre.)

Solid residue	45·40
Loss on ignition	10·60
Chlorine	10·09
Free ammonia	0·01
"Albuminoid ammonia"	0·21
Hardness permanent	18·80
Hardness temporary	0·00

The albuminoid ammonia was determined by the method proposed by Wanklyn, Chapman, and Smith. A preliminary experiment was made on Tuesday evening, with essentially the same result.

On inspecting the numbers it will be apparent that the water is remarkably soft, and contains remarkably little mineral matter, the hardness being *about* 1·3 degree per gallon.

Considered organically, the water is bad. In albuminoid ammonia it is on a par with the Thames at Hampton Court. It is very evident, therefore, that water from Bala Lake will not do for London.

Laboratory, 7, Hilldrop Road, N.

PARIS UNIVERSAL EXHIBITION.

INDIA.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

India.—Minerals—Chemicals—Dyes—Drugs—Chinchona products—Precious stones.

Paris; *July* 15.

It seems singular that throughout the whole of the Indian Peninsula no one could have been found to send a collection of minerals worthy of that vast territory. Beyond a few specimens of iron ore from South Arcot, sent by the East Indian Iron Company, and several samples of red and yellow ochre, contributed by Baboo Kanny Lall Bey, of Calcutta, we have really nothing to interest the mineralogist. Some iron ore is also sent by J. Garrett, and some tin ore from Johore, but the specimens are mostly badly labeled, and so huddled together that identification is almost impossible. Our Indian possessions are undoubtedly extremely rich in economic minerals of all kinds, and a little care and attention on the part of the Indian Government would do much to induce capitalists to come forward and work the numberless mines that exist from one end of the peninsula to the other. When will Government officials, high and low, learn the great lesson that practical men of science are always trying to teach them, that the real riches of a country consist, not only in the products that grow *upon* the soil, but in a still higher degree in those that exist *beneath* it.

There are a few chemicals of fine quality shown by Baboo Kanny Lall Bey and Baboo Dwarkanauth Mookerjee. A large series of specimens of crude saltpetre, from various localities, also deserves examination. Indigo blue, as might have been expected, is well represented by specimens from Indore, Jessore, Burmah, Hyderabad, and other districts. Several samples of safflower, from different localities, are also shown, but we miss any specimens of Indian yellow that would throw any light on the origin of that mysterious pigment. Tincal, too, is absent, although borax is shown by Baboo Kanny Lall Bey. It may be as well to mention that the Indian minerals have been thought unworthy to enter the great building, and have been consequently banished along with the agricultural produce—which, by the way, is particularly complete and interesting—to a shed in the park, devoted to the exhibition of agricultural machinery and sewing machines. Our pharmaceutical friends will be greatly interested in a very beautifully arranged collection of all the chemicals and drugs ordered to be used by the new Indian Pharmacopœia, the work of Dr. E. J. Waring. No doubt our readers, like ourselves, will have long since wondered at hearing no mention of the collection of chinchona plant products that ought to have been sent from the various bark plantations in different parts of India. All that we have to represent the successful labours of so many talented and energetic men during the last eight or ten years are two specimens of stem bark and two of quill bark, both from *Chinchona succirubra* plants, four years and six months old. They are all excellent specimens of the good results of Mr. McIvor's system of mossing. They arrived, however, too late for examination by the jury. This is really too bad. We hardly know to what to ascribe such shameful carelessness, for if ever a series of "*grands prix*" and gold medals were well deserved by any set of men it is by those who have created the Indian chinchona plantations. The Indian Government seem to have exhausted their energies in making a splendid show of Indian textiles and ornamental work of various kinds. The display is certainly a magnificent one, and has possibly not been equalled in any previous exhibition; but it should be remembered that the continuance of all these splendours—nay, the very existence of British rule itself in India—depends on those few specimens of dried bark sent from the Neilgherries, and it is not too much to say that every city of India is

simply built on foundations of chinchona bark, for without it they would undoubtedly speedily become European graveyards. However, Messrs. Markham, McIvor, and the other brave men who have faced every hardship in order to gain their end, must content themselves for the present with the hearty appreciation of every scientific man who understands the value of the great work they have so successfully accomplished. In the Indian court inside the building the mineralogist will find several specimens of manufactured red and white carnelian and bloodstone, and some very singularly marked pieces of natural aventurine.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

Academy of Sciences—Meetings of the 8th inst., and of the 24th of June—Dictionary of Chemistry.

PARIS; *July* 13.

AT the meeting of the Academy on the 8th inst., the dean of the chemical section, M. Chevreul, made the following observations:

"Chemistry is cultivated with such ardour that scarcely a meeting of the Academy passes without receiving communications belonging to this branch of science. After examining the work of the chemists residing in Paris, the section has come to the conclusion that it would be impossible to classify those who, next to the three chemists whose claims upon the vacant seat are above discussion, would be most worthy to belong to the Academy. Such is the difficulty of weighing older and more recent claims, both from the number of workers and from the variety of their work, and considering likewise that the rank in which candidates would be placed to-day might be changed to morrow by new publications, the section refrains from adding any more names to the list of candidates for the vacancy occasioned by the death of M. Pelouze. The section consequently presents the following list:

In the first rank .... M. WURTZ.
In the second rank, *ex æquo*, and in alphabetic order .... { M. BERTHELOT. M. CAHOURS."

The claims of the candidates were then discussed.

The following communications of chemical interest, read on the 8th inst., furnish fresh confirmation of M. Chevreul's estimation of the importance of the chemical work brought before the Academy.

M. Becquerel proves that the deposit of metallic copper in the capillary fissure of a tube filled with nitrate of copper, and placed in another tube containing a solution of sulphide of sodium, is really due to an electrical current. When this system of tubes is connected by a copper wire, bent and dipping into the two solutions, an electrical current is established, negative electricity becoming free in the alkaline solution, and positive electricity becoming free in the acid solution. The end of the copper wire plunged into the sulphide of sodium becomes positive, the end plunged into the metallic solution becomes negative, the solutions communicating with each other through the fissure. The negative pole is soon covered with copper and the sulphide of sodium transformed into hyposulphite and nitrate. In this experiment the fissure only acts by establishing a contact. No copper is deposited in it. But this deposit will appear as soon as the copper wire is taken away. Then evidently parts of the fissure perform the functions of the wire. The electric circuit is then formed of two solutions and the surface of the fissure into which they penetrate by capillary action. The molecular difference existing between the liquids inside and outside the fissure suffices to establish an electric circuit without the intervention of a metal. I am obliged to pass by a great number of details contained in this interesting memoir.

M. Daubrée reports upon the *classification of meteorites* in the museum of natural history. The chief classes established are those of siderites, or those that contain metallic iron, and asiderites, that contain only oxides.

Father Secchi describes the *nebula of Orion*, proved by spectroscopic analysis to be formed of gases.

M. Zinin, in a paper on *benzoine and its derivatives*, reports on the different bodies already described by him in former publications, and which M. Grimaux has lately succeeded in representing by rational formulæ. M. Zinin adds the following new compound to those already known:

Benzoine heated with hydrochloric acid to 160° doubles in loosing water, so as to form a crystalline body of the formula $C_{28}H_{20}O$, which he calls *lepidene*. Nitric acid transforms it easily into $C_{28}H_{20}O_2$, oxylepidene, and bromine into bibromolepidene, $C_{28}H_{18}Br_2O$.

The reaction may be represented by the formula—

$$\underset{\text{Benzoine.}}{3C_{14}H_{12}O_2} = \underset{\text{Lepidene.}}{C_{28}H_{20}O} + \underset{\text{Benzile.}}{C_{14}H_{10}O_2} + 3K_2O.$$

MM. Reboul and Truchot communicate researches on *isomerism in the acetylenic series*.

Diallyle $(C_3H_5)_2$ boils at 59°. Hexoilene, C_6H_{10}, obtained through the action of potassa on brominated hexylene, boils at 76—80°. The former is transformed by bromine into a tetrabromide, the second into a dibromide. Some of these results have already been published by M. Caventon.

Decylene, $C_{10}H_{20}$, obtained from petroleum, has been transformed into brominated decylene, $C_{10}H_{19}Br$, boiling at 215°, and yielding with potassa the hydrocarbon $C_{10}H_{18}$, *decanylene*. This body boils at 165°, while the isomeric rutylene obtained by M. Bauer from diamylene, $(C_5H_{10})_2$, boils at 150°.

M. Hiortdahl describes a new sulphide of cobalt, to which he gives the formula $Co_4S_3 = Co_2S + 2CoS$. He has obtained it by heating oxide of cobalt in sulphuretted hydrogen. By fusing together sulphate of cobalt and sulphide of barium he obtained another sulphide, indicated by him as protosulphide of cobalt, CoS.

At the meeting of the Academy of the 24th of June, a report upon which I posted to you, though it does not appear to have reached you, the only

paper read of chemical interest was by M. Silva, and treated of the *action of cyanate of amyl on potassa.* It was found that besides monamylamine, also diamylamine was produced by this reaction.

The *Dictionary of Chemistry*, of which the first part, treating of the letter A, is intended to appear in November, will comprise pure and applied science in two large volumes. M. Wurtz, the chief editor, will introduce the undertaking by a Preliminary Discourse on the history of chemical theories. He will also contribute, for the first part, the articles on Atomic Weights and Atomicity. The following chemists have also written articles for this undertaking:

MM. Bonis, Caventon, De Clèrmont, Debray, Delafontaine, Friedel, Gautier, Grimaux, Hautefeuille, E. Kopp, Lauth, Naquet, Salet, Schützenberger, Troost, and Willm.

The publishers, Messrs. Hachette et Co., have entered into arrangements which will permit THE LABORATORY to publish extracts of the most interesting articles of this important publication.

Dictionaries on natural philosophy, pure and applied mathematics, history, geography, and biography, have been published or are about to be published by the same firm.

July 15.

The election of M. Wurtz as member of the Academy, and its meaning—Dinner to celebrate the election.

The election is just over. M. Wurtz has carried off the palm with 46 votes out of 53, two of which were given to M. Cahours and three to M. Berthelot.

This is welcome news indeed. This election has broken the charm by which the Academy has long been the stronghold of conservatism in scientific matters. The prize withheld from Laurent and Gerhardt has fallen to Professor Wurtz, as an acknowledgment of his great scientific attainments, the importance of his original discoveries, his indefatigable ardour and power of work, and his influence over a school of younger chemists. Modern chemistry is no longer a stranger in the council of this great scientific corporation. But beyond this satisfaction of an almost personal character, there is another and a higher reason for contentment.

Tolerance and that spirit of liberalism which accepts views differing from our own is wanting in official France. A fixed programme ties down the professors of all Government schools to a narrowly defined method of teaching. This is the reason, alluded to in the first number of THE LABORATORY, which has kept France from progressing as rapidly in the path of modern science as the neighbouring countries. But, in framing these programmes, the Minister of Public Instruction takes counsel from the men officially considered to be the highest in their respective branches of knowledge, and such are the members of the five academies. An unwholesome and illiberal spirit of restraint will never be defended by M. Wurtz, and his election, therefore, is not only a triumph of the theories that are, but also a warranty for the unfettered development of future doctrines that will rise one after the other.

A dinner, to celebrate this election and to express gratitude and friendship to M. Wurtz, has been arranged to take place to-morrow (Tuesday, the 16th inst.). About twenty or more of his present and former pupils will take part in this meeting, amongst whom we may mention Dr. Maxwell Simpson and Dr. Atkinson.*

CORRESPONDENCE.

ACIDUM NITRO-HYDROCHLORICUM DIL. B.P.

To the Editor of THE LABORATORY.

SIR,—Having undertaken an examination of some of the acids of the British Pharmacopœias, I am induced, as the result of my experiments, and before their publication in full, to criticise the formula for the production of nitro-hydrochloric acid, as detailed in the work of 1867. In order to render my comment the more readily intelligible, I subjoin the formulæ of the Pharmacopœias of 1864 and 1867:

Acidum Nitro-hydrochloricum Dilutum. B. P., 1864.

Nitric acid s.g., 1·5	2 fluid ounces.
Hydrochloric acid s.g., 1·17	4 „
Distilled water	26 „

Add to the water, first the nitric acid, and then the hydrochloric acid. Mix, and preserve in a stoppered bottle.

Tests.—Specific gravity, 1·074; six fluid drachms require for neutralisation 93·88 measures of the volumetric solution of soda.

Acidum Nitro-hydrochloricum Dilutum. B. P., 1867.

Nitric acid s.g., 1·42	3 fluid ounces.
Hydrochloric acid s.g., 1·16	4 „
Distilled water	25 „

Mix the acids, and allow them to remain for twenty-four hours in a bottle, the mouth of which is partially closed, then add the water in successive portions, shaking the bottle after each addition, and preserve the mixture in a stoppered-bottle.

Characters and Tests.—Specific gravity 1·074; 352·4 grains, by weight (6 fluid drachms) require for neutralisation 920 grain-measures of the volumetric solution of soda.

It is presumable that the products of these two formulæ will not be mixtures having the same specific gravity, and virtually the same neutralising power, and, therefore, that the characters and tests given in the Pharmacopœias need revision. The results of an examination of the two mixtures are as follows:

The specific gravity of the acid of 1864 is 1·070, and requires 938·8 grain-measures of volumetric solution of soda; there appears to be no loss by the combination.

The specific gravity of the acid of 1867 is 1·063, and requires 840 grain-measures of volumetric solution of soda; the loss of acid during the twenty-four hours allowed for combination being very considerable.

Even with a work so carefully compiled as the 'British Pharmacopœia' of 1867 perfect accuracy is scarcely attainable as expected, and I point out this discrepancy in the hope that the indication may be useful, and not with the intention of making hypercritical observations.

I am, Sir, your obedient servant,

W. E. HEATHFIELD.

Wilson Street, Finsbury.

* *Errata.*—In 'French Correspondence,' p. 271, second column, in line 30, read $C_{10}H_{14}$, instead of C_7H_{14}. In last line, read "combinations," instead of "combine together."

LIEBIG'S RECOLLECTIONS OF GAY-LUSSAC AND THÉNARD.

We present our readers with a full report of Baron Liebig's remarkable speech at the International Banquet of Chemists at Paris. M. Balard having proposed Liebig's health in terms of unqualified admiration, the Baron replied:—

Gentlemen,—I assure you that I am deeply touched and extremely thankful for the sentiments which my hon. *confrère*, M. Balard, has just expressed concerning me. Being called upon in my turn to propose a toast, I will give you one which I am sure will meet with your fullest approbation. I am going to propose a toast to the memory of two of the greatest French chemists—of two of the founders of modern science, whose admirable works have never been surpassed, and still remain our models—of two *savants* who, as men, represent the most elevated qualities of the French nation. You will guess that I allude to Gay-Lussac and Thénard.

You all know, gentlemen, the great discoveries which we owe to the united efforts of these two men, connected by the ties of the closest friendship, and whose works, indeed, have their origin in that very friendship.

You know why their names will always remain inseparable in the history of science. You are fully aware, gentlemen, of the merits of Gay-Lussac and of Thénard, but there are few amongst you who have had the good fortune of being personally acquainted with these learned men. I feel called upon to pay them my tribute of gratitude by addressing a few words to you. What they both did for me will suffice to show you what they did for many others.

I arrived in Paris forty-four years ago as a young student, a mere boy of nineteen years, without any recommendation except my desire for learning. I had brought with me to Paris a small work on the fulminating compounds of silver and mercury, and I addressed myself to M. Thénard to present it to the Academy.

The President of the Academy (for Thénard occupied that position at the time) received the young foreign student with the greatest kindness. The note was read by Gay-Lussac, and Dulong made the report on it.

From that moment I had the warmest friends in Paris. M. Thénard placed me in a laboratory where I might pursue my labours, and my good fortune was at its highest when M. Gay-Lussac admitted me to his house, opened his laboratory in the Arsenal to me, and proposed that I should stay with him to finish my work on fulminating silver and mercury.

This was what decided the aim of all my subsequent works. He used to say to me repeatedly, "You must occupy yourself with organic chemistry, M. Liebig; that is what we are in want of." I believe that I was his first pupil. After me he had my friend Pelouze, whom a cruel malady keeps away from us to-day. [The death of Pelouze occurred soon after the banquet.]

I shall never forget the hours spent in the laboratory of Gay-Lussac. When we had finished a good analysis (you know, without my telling you, that the method and apparatus described in our joint memoir were by him alone)—when we had finished a good analysis, he used to say to me, "Now you must dance with me, as I used to dance with Thénard when we had found something good." And then we danced.

Gentlemen,—You have often heard Thénard called Father Thénard, and he was, indeed, a father to us—a father to all of us, who always offered and never refused to lend a hand to the weak, to assist them to mount the steps of the ladder and to overcome difficulties.

M. Dumas can say something on that head; he was, as he deserved to be, the favourite of Thénard. On this point there could not be two opinions—he was then the first among us, and he remains the first.

Thus, gentlemen, I give you the memory of Gay-Lussac and of Thénard, the founders of our modern science, and the representatives of the highest qualities of French character.

EDITORIAL NOTES.

COOKED OPINIONS OF THE PRESS.

Though the practice of "cooking" quotations for advertising purposes has been repeatedly exposed by our literary contemporaries, we fear that scientific book buyers are often deceived by the judiciously selected and mutilated passages which are presented to them as opinions of the press. With the aid of a pair of scissors and a bottle of gum, a publisher who is blessed with an elastic conscience can easily reduce any series of critical notices to a commendatory piece of patchwork. The most severe article may thus be turned to good account, for a writer cannot avoid using by-sentences which form eligible quotations when detached from the essential parts of his critique.

These remarks have been called forth by an instance of the suppression of truth in collected opinions of the press which has lately come under our notice. A little book entitled 'Chemical Notes' was sent to us for review in May last, and, as our readers will doubtless recollect, we described it as a jumble of contradictions, misstatements and absurdities, and justified our animadversions by some "elegant extracts." We endeavoured to express our firm conviction that the book was utterly worthless as a guide for students, and we are quite sure that no chemist of standing *who has read the book* will venture to assert that our review was a misrepresentation.

Much to our surprise, we find that an extract from our article has been printed in a handbill, with passages from other reviews of a very different character. The extract is simply our summary of the author's own preface, and does

not afford the slightest indication of the opinion we so plainly expressed. Yet, as it is printed with the extravagant commendations of the 'Chemical News' and 'British Medical Journal,' the readers of the advertisement will naturally conclude that THE LABORATORY has spoken of the work in the same strain. If the extract from our review was not printed to deceive the public, we should be glad to know why it appears in the handbill.

We cannot agree with the 'Chemical News' in thinking that Dr. Wood has succeeded in preparing a "short text-book on the subjects required to answer the same purpose that Newth's 'Mechanical Philosophy' now serves in another subject;" nor can we indorse the opinion of the 'British Medical Journal,' that the work is "the solidified extract of chemistry for examinations," containing "in a digestible form all that the student wants for his pass examination." We say that the book is immeasurably inferior to Newth's text-book, and that it is not the kind of extract of chemistry that a student requires. If THE LABORATORY is referred to in future advertisements of this book, we trust that its peculiar opinions may be indicated.

THE REMEDY FOR CRAMMING.

WE saw the other day an advertisement which stated that young gentlemen were "rapidly and successfully prepared" for the Civil Service and other examinations. Of course if a young gentleman is to be prepared for an examination, it is very desirable that the preparation should be successful, and that it should be accomplished as speedily as possible, for any lengthening of the process beyond what is absolutely necessary must prove to be a waste both of time and money. Still, it was impossible not to be led by a just association of ideas, to think of the rapid despatch of orders guaranteed by large wholesale houses, or of that rapid and successful brushing of the hair which is effected by machinery. One could not help picturing to oneself large assortments of "mixed" answers duly labelled, sorted and arranged in the pigeon-holes of dull brains, or of general information forced into the heads of several pupils in a row by means of a single axle driven by some power hidden in the next room. Yet the gentleman who paid for the advertisement, doubtless saw no harm in it, thought most likely that the wording of it was remarkably neat and effective. And how could he do otherwise? His mental horizon is naturally bounded by his duty and task in life, that of pushing youths with all the force he has towards and by good fortune through certain narrow gates.

The remedy for this pestilent system of cramming, which is eating into the very heart of our education, lies in the hands of one class of persons, and of one class of persons only. It is, perhaps, difficult to overestimate the amount of power for good and for evil that is placed at the disposal of these gentlemen who act as examiners for educational institutions and public bodies. They are intellectual monarchs with almost despotic powers, and with very few and slight restrictions. They can make and unmake lecturers and tutors, they can suspend, diminish, or increase the sale of this book or that, according to the character of the questions they put to candidates. The chief inquiry of the student about to attend Professor A.'s lectures is, Will they equip me for the B. examination? The first question of a university publisher, when he is offered a new text-book is, For what examination will it prepare the student? Were all examiners, with one accord, so to frame their examinations as to make them touchstones of real knowledge, the whole system of cramming would wither away in a twelvemonth.

Unhappily only the most talented men can do this, or perhaps the work requires rare talent of a special kind. And it is obvious that a large share of examinations must be carried on by second rate, or even by third and fourth rate men. So that the matter seems almost hopeless,

In the physical and natural sciences, however, we may hope for better things, if the habit of making examinations entirely practical can be made much more general than it is. The scolastic mind is burdened with a superstition that examinations are not proper unless they are conducted by means of printed papers, with, at most, an additional *vivâ voce* interview. Let this idea be thrown away to the winds. Let the examinations in physics and chemistry consist wholly of a repetition by each student of fundamental observations and experiments, and cramming will be known no more, as far as these sciences are concerned. The University of London has been a noble forerunner in this matter, but the whole system wants vastly extending. Of course a practical examination, on a large scale, of students will be a much more expensive affair than the printing of a few copies of some dozen questions; but how can that be considered a real obstacle to so desirable a change? Such an examination, moreover, cannot possibly be conducted by one man single-handed; but a system which would give employment to many young followers of science would be doing a double good, and it is fair to expect that the more apparent the good effects of such a measure became, the greater

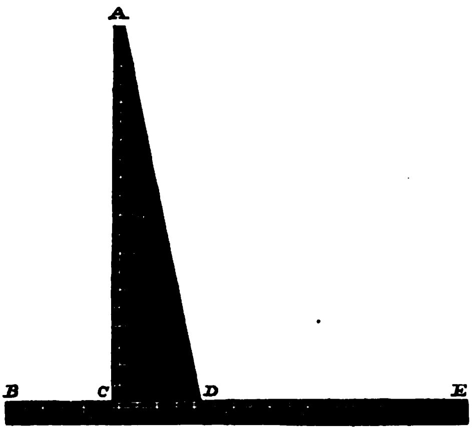
would be the amount of emolument falling to duties now shamefully ill paid.

Since the natural and physical sciences are those branches of education in which alone real knowledge can thus be easily (though expensively) recognised, it becomes still more an object of national importance to make them a large part of national education.

THE CURVE PLOTTER.

It may be worth while to draw the attention of chemists to the simple arrangement represented in the annexed figure, which is in use for plotting curves. Divided paper is not often at hand in a laboratory, and is rather expensive when much is used.*

A C D is a set square with the edge AC bevelled and divided into millimeters. BE can be kept firm on the table by two lead weights,



or two clamps; CD, BE are true straight lines, so AC remains parallel to itself, as A C D slips up and down BE. Further explanation of the use of this arrangement seems unnecessary.

UNIVERSITY OF LONDON—MATRICULATION.

About four hundred candidates for matriculation were examined in June. Of these, 216 passed—34 with Honours, 142 in the First Division, and 40 in the Second Division.

Critical notices of Professor Hirst's English edition of 'Clausius on the Mechanical Theory of Heat,' and of Professor Miller's 'Chemical Physics,' are in type, and will probably appear in our next. Dr. Matthiessen and Mr. Hockin are preparing for us a series of papers on the Determination of the Electrical Conducting Powers of Metals.

* For the information of those who may not be aware of it, we may state that section paper can be obtained from Waterlow and Sons, 65 to 68, London Wall.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S., AND E. J. MILLS, D.SC.

On Benzylic Chloride. By Ch. Lauth and E. Grimaux.*

This compound, $C_7H_7Cl = C_6H_5,CH_2Cl$, discovered by Deville in 1841, is prepared by distilling toluene in a current of chlorine. A convenient way of operating is to boil the toluene in a flask communicating on the one side with a Liebig's condenser, which allows the condensed vapours to flow back again, and on the other with a vessel for generating chlorine. If the flask is completely filled with toluene-vapour, the chlorine is immediately absorbed. The action of the chlorine must not, however, be pushed to the utmost, as in that case more highly chlorinated products will be formed. It is best, therefore, to keep the temperature of the vapour between 110° and 140°, and as soon as this limit is passed, distil the product, collect the portions which pass over below 170°, and again submit them to the action of the chlorine. In this manner, after a few rectifications, a quantity of benzylic chloride is obtained equal to about 91 p. c. of the toluene employed, and distilling between 170° and 180°, the greater portion also between 175° and 178°. Benzylic chloride, according to Cannizzaro, boils at 176°. A certain quantity of more highly chlorinated product always remains in the retort in the form of a thick irritating oil.

Benzylic chloride, heated for two hours with an equal weight of *nitric acid* at 27°, diluted with ten times its bulk of water, is converted into benzoic hydride (bitter-almond oil).

$$C_7H_7Cl + NHO_3 = C_7H_6O + HNO_2 + HCl.$$

To obtain the benzoic hydride pure, half the water is distilled off, and the supernatant oil is washed, and heated with acid sulphite of sodium: the resulting sulphite of benzoyl-sodium, freed from excess of benzylic chloride by alcohol, and distilled with an alkali, yields pure benzoic hydride.

The mother-liquors of the preparation contain benzoic acid. The formation of this more highly oxidised product may, however, be avoided, and the yield of benzoic hydride increased, by using nitrate of lead instead of nitric acid, and operating in a current of carbonic acid gas. 14 grms. nitrate of lead, 100 grms. water, and 10 grms. benzylic chloride, boiled for an hour in a flask communicating with a Liebig's condenser, yields a good product.

Benzylic acetate, oxidised by nitric acid, also yields benzoic hydride.

Benzylic chloride, boiled with recently precipitated *oxide of lead*, is converted into benzylic alcohol:

$$2C_7H_7Cl + PbH_2O_2 = 2C_7H_8O + PbCl_2.$$

Heated with an equivalent quantity of *potassic phenate* in alcoholic solution, it yields benzylic phenate, $\left.\begin{matrix}C_6H_5\\C_7H_7\end{matrix}\right\}O$.

* 'Bull. Soc. Chim.' [2], vii, 105.

On distilling off the alcohol from the filtered liquid, a thick oil is obtained, which solidifies after some time; and on redissolving this product in alcohol, and adding water till a milky emulsion is formed, the liquid, after some hours, becomes filled with crystalline scales of benzylic phenate. This compound melts at a temperature a little above 40°, and may remain liquid for a long time after cooling, but solidifies instantly when touched with a rod which has been in contact with the solid compound. At a high temperature it decomposes.

The authors have also prepared benzylic valerate, but it is decomposed by distillation.

Benzylic chloride, heated to 115°, in a close vessel with *rosaniline*, or its chlorhydrate, in alcoholic solution, yields a very fine violet colouring matter, in the form of a dry mass, having a shining lustre and bronze-green colour, and insoluble in water. To obtain a good violet, however, the treatment must be repeated three or four times. The base, set free by soda, is colourless at the moment of precipitation, but soon turns blue on exposure to the air.

Chlorobenzol.—The chlorinated products which remained in the retort after the benzylic chloride had been distilled off were rectified, and the portions distilling between 200° and 210° were collected. According to Kekulé's theory, there are three possible dichlorinated derivatives of toluene, viz.—

$$C_6H_3Cl_2.CH_3 \quad C_6H_4Cl.CH_2Cl \quad C_6H_5.CHCl_2.$$

The last is the chlorobenzol of Cahours, which boils at 206°.

The body $C_6H_3Cl_2.CH_3$, is chlorinated benzylic chloride, which boils at about 202°; the constitution of this compound was demonstrated by Naquet, who converted it by means of alcoholic potash into oxide of chlorobenzyl and ethyl, $\left.\begin{matrix}C_6H_4Cl.CH_2\\C_2H_5\end{matrix}\right\}O.$

The products collected as above between 200° and 210° contained chlorobenzol, for when heated with oxide of lead they yielded benzoic hydride—

$$C_7H_6Cl_2 + PbO = C_7H_6O + PbCl_2.$$

On the Chlorinated Derivatives of Xylene. By Ch. Lauth *and* E. Grimaux.*

The process above described for converting toluene into chloride of benzyl, by subjecting the vapour to the action of chlorine, has also been applied to the higher homologue of toluene, viz.—xylene or dimethyl-phenyl, $C_8H_{10} = C_6H_4\,(CH_3)_2$.

Monochloroxylene, C_8H_9Cl.—When chlorine is passed for several hours into xylene-vapour, chlorhydric acid is abundantly evolved, and a chlorinated product is obtained, which irritates the eyes, and, after repeated fractional distillation, yields monochloroxylene, distilling between 190° and 195°, with a stationary point at 192°. The portions collected between 195° and 200° also contain considerable quantities of the same compound.

Monochloroxylene is a limpid, colourless liquid, which strongly irritates the eyes. It precipitates nitrate of silver, even in the cold; when boiled with acetate of silver, it yields chloride of silver and a liquid having an agreeable odour, similar to that of benzylic acetate, and probably consisting of tolylic acetate.

When 2 at. monochloroxylene are heated for an hour with 1 at. nitrate of lead and a considerable quantity of water, the monochloroxylene is converted into a liquid which smells like bitter-almond oil and oil of cinnamon, unites with acid sulphite of sodium, and distils, after purification, at 200°. This liquid is evidently tolylic aldehyde, C_8H_8O, which, according to Cannizzaro, boils at 200°. These reactions show that monochloroxylene may be regarded as the chlorhydric ether of tolylic alcohol, and represented by the formula $C_6H_4\left\{\begin{matrix}CH_2Cl\\CH_3\end{matrix}\right.$.

Dichloroxylene, $C_8H_8Cl_2$.—The portions of the crude chlorinated product above mentioned, which distil between 230° and 260°, deposit a solid substance, which is especially abundant in the higher portions. To obtain it from the liquids which distil between 230°—240° and 240—250°, these liquids must be cooled by a freezing mixture.

The solid substance, when purified by filtration and pressure, forms white scales having an irritating odour. It dissolves in ether, and is deposited therefrom in very fine crystals, having the composition of dichloroxylene. From alcohol it crystallises in rhombic laminæ, and from ether-alcohol, by very slow evaporation, in splendid transparent crystals of considerable size. It melts at 100°, solidifying to a radiate mass, and distils with decomposition between 240° and 245°.

The authors have not yet obtained this compound in sufficient quantity to study its reactions and determine its rational formula; but, according to Kekulé, xylene should yield four isomeric dichlorinated derivatives, viz.—

$$C_6H_2Cl_2\left\{\begin{matrix}CH_3\\CH_3\end{matrix}\right. \quad . \; C_6H_3Cl\left\{\begin{matrix}CH_2Cl\\CH_3\end{matrix}\right. \quad C_6H_4\left\{\begin{matrix}CHCl_2\\CH_3\end{matrix}\right.$$

$$C_6H_4\left\{\begin{matrix}CH_2Cl\\CH_2Cl\end{matrix}\right.$$

On Chrysene and Anthracene. By M. Berthelot.*

The names *pyrene* and *chrysene* were given by Laurent to two solid hydrocarbons extracted from the less volatile portion of coal-tar. Neither of these products, however, as obtained according to Laurent's directions—that is to say, by the use of ether alone, which dissolves the former and leaves the latter—can be regarded as a strictly definite compound.

Pyrene, after more complete purification, appears to be identical with anthracene, $C_{14}H_{10}$, with which also the paranaphthalene of Dumas is either identical or homologous.

The nature of chrysene is more doubtful. The product prepared by Laurent's method contains a very large quantity of anthracene, and the name chrysene has been extended to various hydrocarbons of the same, or nearly the same, composition, obtained

* 'Bull. Soc. Chim.' [2], vii, 233.

* 'Bull. Soc. Chim.' [2], vii, 43.

towards the end of the distillation of certain pyrogenous products. The formula, $C_{12}H_8$, attributed to these hydrocarbons appears to be much too low, inasmuch as their boiling-points are considerably above that of mercury. For these reasons Berthelot proposes to restrict the name chrysene to the hydrocarbon $C_{18}H_{12}$, produced, together with others, when benzene is heated in a porcelain tube to a temperature above 300.* This hydrocarbon is likewise contained in *crude anthracene*, the complicated product which passes over after naphthalene in the distillation of coal-tar, and consists mainly of anthracene properly so called, mixed with several other hydrocarbons, some more, some less volatile.

1. *Anthracene, properly so called*, $C_{14}H_{10}$.—This is the hydrocarbon specially studied by Anderson.† It is easily obtained pure by distilling crude anthracene, rejecting the first and last portions, and crystallising the intermediate portion, either from alcohol, or from coal-oils boiling between 100° and 120°. When thus prepared it forms white, shining, crystalline laminæ, having a slightly micaceous aspect. It is difficult to recognise their form by the microscope, but by leaving an alcoholic solution saturated while hot to cool in the focus, rhomboïdal or nearly square laminæ are often observed; but they quickly lose their shape by aggregation as the liquid cools. Moreover, these appearances are seen only when the anthracene is pure and slowly deposited from dilute solutions; if either of these conditions is unfulfilled, the anthracene is precipitated in whitish grains, which, however, exhibit a lamellar structure under the microscope. The appearance of sublimed anthracene is also very different according as the sublimation takes place quickly or slowly. By slow sublimation in a feeble current of gas, it is deposited in very thin transparent crystalline laminæ, somewhat like those of naphthalene, but smaller and less regular. By rapid sublimation, on the other hand, it passes suddenly to the solid state, and is precipitated as a powder or in light flocks, which are carried forward by the current of gas, and sometimes remain suspended in the air, irritating the eyes and throat of those who are exposed to them. Anthracene, indeed, notwithstanding its high boiling-point, has a disagreeable, irritating odour, and it evaporates so easily that the fusion of a few grammes in a capsule is a matter of considerable difficulty.

Anthracene is colourless when quite pure; but it obstinately retains traces of yellow substances, which impart to its solutions a greenish fluorescence, like that of uranic salts.

Anthracene boils between 320° and 330°, and melts at about 213°; but its precise melting-point is difficult to determine. Anthracene is, in fact, intermediate in its characters between the waxes and the resins. When once melted it does not solidify till cooled to a temperature much below the melting-point, and varying, moreover, according as the body has been more or less heated above that point, and according to the rapidity of the cooling. A thermometer immersed in melted anthracence does not indicate any rise of temperature at the moment of solidification. The temperature at which anthracene which has once been melted melts a second time, depends also on the conditions just mentioned; further, on the temperature to which the solidified anthracene has been cooled below its melting-point; and finally, on the time which has elapsed since the previous fusion.

All these conditions influence the arrangement of the particles of the solid anthracene, which, indeed, like most waxy and resinous bodies, appears to be susceptible of an unlimited number of states of unstable equilibrium. The passage from each of these states to that of perfect fusion requires the expenditure of a certain amount of work, different in each case, a fact formerly expressed by saying that the latent heat of fusion was variable. Moreover, anthracene does not, like water, pass into a definite state as soon as it is melted, but only when the liquid is raised to a considerably higher temperature.

All these circumstances render it difficult to fix the normal melting-point of anthracene, but the number 213° given by Anderson may be regarded as near the truth.

The characters above enumerated, together with the sparing solubility of anthracene in alcohol and most other solvents at ordinary temperatures, and the appearance and mode of formation of its picrate,* constitute the chief properties which can be established for this hydrocarbon without causing it to undergo a definite chemical alteration.

2. *Bodies probably homologous with Anthracene—Paranaphthalene, Retene, etc.*—When crude anthracene is distilled, the boiling-point does not remain constant, but quickly rises above that of mercury. The distillate, which passes over at high temperatures, consists in great part of anthracene, but contains also other very similar hydrocarbons, not differing sensibly from it in composition, which solidify in the last products.

On fractionating the distillate by tenths, the ninth volatile portion exhibited nearly the same appearance as pure anthracene, in the solid state, in alcoholic solution, and in its picric compounds. There are, however, marked differences in its modes of fusion, evaporation, and solution.

(*a*) *Fusion.*—The crude product subjected to an increasing temperature yielded a semi-transparent liquid at 160°, and fused completely at 180°; on cooling it began to exhibit opacity at 145°, but did not solidify completely till about 130°. These points are much lower than those observed with pure anthracene; they are also less distinctly marked—in fact, the mass, when subjected to increasing heat, melts gradually, separating into heterogeneous portions by a sort of liquation, and the thermometer may be moved about freely in an already transparent liquid, whilst another portion remains solid and crystalline, and floats on the liquid without alteration of appearance —at least, unless the temperature is further raised. It appears, then, that these hydrocarbons, like metals,

* 'Bull. Soc. Chim.' [2], vi, 276.
† 'Ann. Ch. Pharm.,' cxxii, 294.

* See LAB., No. 14, pp. 257, 258.

cannot dissolve one another in all proportions. The solidification of the mass likewise takes place by successive portions, exhibiting phenomena the converse of the above. The fusion and solidification of the mixture of hydrocarbons under consideration take place between limits of temperature separated by 50 or 60 degrees.

The mixed nature of the above-mentioned portion of crude anthracene may be still further demonstrated by evaporation and solution.

(β) *Evaporation.*—When this product is carefully evaporated, without ebullition—as, for example, in a small capsule, or on the bulb of a thermometer—the melting-point of the more fixed portion becomes continually lower and further removed from that of pure anthracene. In fact, the less volatile hydrocarbons which are mixed with anthracene are more fusible than anthracene itself.

These results may be explained by reference to the formula and melting-point formerly assigned to paranaphthalene, which, according to Dumas,* consists of $C_{15}H_{12}$, and melts at 180°. It is easy, however, by repeated sublimation and solution (which is Dumas' process) to bring the melting-point of anthracene several degrees higher than this, namely, to 210°; hence it is probable that Dumas' product was not true anthracene. Now, methyl-anthracene, $C_{14}H_{10}.CH_2$, the nearest homologue of anthracene, has exactly the formula assigned to paranaphthalene, and should, moreover, be somewhat less volatile than pure anthracene, so that it may be expected to occur amongst the hydrocarbons obtained towards the end of the distillation of crude anthracene, which hydrocarbons, as already abserved, melt at temperatures below the fusion-point of pure anthracene and near that of paranaphthalene. It appears probable, therefore, that the product examined by Dumas was rich in homologues of anthracene, especially methylanthracene. The vapour-density observed by Dumas, namely, 6·74,† is in accordance with this supposition. The centesimal composition of the several homologues of anthracence does not differ sufficiently to yield very definite results by analysis.

The supposition that methyl-anthracene has a lower melting-point than anthracene may be corroborated by other facts—for example, by the melting-point of retene, $C_{18}H_{18}$, or tetramethyl-anthracene, $C_{14}H_{10}.(CH_2)_4$, which is 95°. Anthracene and retene, which differ by $4CH_2$, differ in melting-point by 110°, the fourth part of which, corresponding to a difference of CH_2, is 22°. According to this, the melting-point of methyl-anthracene should be 190°, and Dumas' paranaphthalene is said to melt at 180°.

The phenomena observed with the least volatile portions of crude anthracene agree, moreover, with those exhibited by a mixture of pure anthracene and retene. When such a mixture is melted and left to cool, the anthracene separates out first. The melting-point of the mixture [in what proportions?] is about 140°; it then falls successively to 130°, 115°, and finally to 100°, which is nearly that of pure retene.

* 'Ann. Ch. Phys.' [2], i, 189.

† $C_{14}H_{10}$ corresponds to 6·1; $C_{15}H_{12}$ to 6·7.

(γ) *Solution.*—On dissolving the distillate of crude anthracene in boiling alcohol, and filtering at the boiling heat, the first deposit formed in the filter itself consists of beautiful, light, shining, crystalline scales, which melt at 190°. The second product, formed in the precipitating vessel as the liquid cools, consists of similar scales, melting at 187°, and solidifying at 180°; it resembles anthracene in appearance, and forms a picrate crystallising in red needles. The third deposit obtained by concentrating the mother-liquor, melts at 145° and solidifies at 140°, and likewise yields a red pricrate. The last product, obtained by evaporating the mother-liquor to dryness, has a pasty consistence, being, in fact, a mixture of a heavy oil with a crystalline hydrocarbon; when boiled with an alcoholic solution of picric acid saturated in the cold, it deposits three kinds of crystals, namely, red needles, orange needles, and tufts resembling picrate of chrysene.

It appears from these observations that the several hydrocarbons in the mixture become more fusible as they are more soluble in alcohol, as if the portions of increasing solubility consisted of successive homologues of anthracene. The aspect of these successive portions is more and more crystalline, approaching in that respect to retene. Moreover, the last product yields an orange-coloured picrate, the colour of which is similar to that of picrate of retene. Nevertheless, Berthelot has not hitherto succeeded in actually extracting retene from crude anthracene, probably because it exists in too small quantity to be isolated, not being stable at a red heat. Moreover, the examination of these last products shows that the melting-point rises and the solubility diminishes as the composition of the residue approximates to that of a mixture of chrysene and benzerythrene.

The above conclusions are corroborated by the fact that retene is more soluble in alcohol than anthracene. When a mixture of four parts anthracene and one part retene, melting at 170°, was dissolved in alcohol, the anthracene was concentrated in the crystals first deposited; the portion remaining in solution melted at about 130°; and by a series of solutions and crystallisations the less soluble anthracene was separated out, and the retene was again obtained, with its fine crystalline character and proper melting-point.

It appears, then, that the solubility in alcohol, the fusibility, and the crystallising tendency of the homologues of anthracene as high as retene, go on increasing with the number of carbon-atoms contained in them, a relation exactly contrary to that which is observed in the series of fatty acids $C_nH_{2n}O_2$. This anomaly may doubtless be attributed to the rapid increase in the centesimal proportion of hydrogen in the first homologues of anthracene, that body, in fact, containing only 5·6 per cent. of hydrogen, whereas methyl-anthracene contains 6·3 and tetramethyl-anthracene (retene) contains 7·7 per cent. The homologues of anthracene may, in fact, be regarded as compounds of that hydrocarbon with hydrocarbons of the formula C_nH_{2n} analogous to paraffin: hence, as their molecular weight increases, they depart more and more from the resinous character of anthracene,

and approximate in fusibility, solubility, and other physical characters, to paraffin.

3. *Hydrocarbon volatile towards 260° contained in crude Anthracene.*—This hydrocarbon was isolated by first collecting apart the portion which distilled below 320°, then redistilling, collecting that which passed over below 300°, and so on. After six fractional distillations, a product was obtained volatile at about 260°, but still not quite homogeneous, as it began to melt at about 60°, but was not completely melted till heated to 85°.

The same hydrocarbon was obtained by distilling crude naphthalene, being concentrated in the last portions, which volatilised above 220°. The quantity of it present in coal-tar is but small as compared with the naphthalene and anthracene.

This hydrocarbon is much more crystalline than anthracene, and dissolves more easily in various solvents. The solution in hot alcohol deposits, on cooling, large polygonal laminæ, with curved and irregular sides. It is further distinguished from anthracene and from naphthalene by the character of its picrate (p. 258). It is probably isomeric with phenyl, and identical with a lamellar hydrocarbon formed by the action of ethylene on benzene, and having the composition of naphthalene with 2 at. hydrogen replaced by ethylene—

$$C_{10}H_6(C_2H_4) = C_{12}H_{10}.$$

4. *Chrysene and Benzerythrene in crude Anthracene.*—These hydrocarbons are found in the last product formed by the distillation of crude anthracene, and in the residue left in the retort; in larger quantity also in the last products of the distillation of pitch. They are distinguished by the characters of their picrates (p. 258).

On a new Class of Organic Acids. *By* P. Griess.*

Perbromide of diazobenzoic acid is decomposed by solution of ammonia in the following manner:

$$C_7H_4N_2O_2,\ HBr,\ Br_2 + 4NH_3 = \underset{\text{New compound.}}{C_7H_5N_3O_2} + 3NH_3HBr.$$

The new compound crystallises in white thin leaflets, and is soluble in alcohol, ether, and hot water (with difficulty), but not in cold water. It fuses at 160°, decomposes with a weak explosion when heated on platinum foil, and behaves as a well characterised acid. The silver salt probably has the formula—

$$C_7H_4AgN_3O_2.$$

The constitution of the acid is best shown by the expression—

$$\left.\begin{matrix}(C_7H_4N_2O_2)''\\ H\end{matrix}\right\} N$$

which represents *diazobenzimide.*

The perbromides of diazodiacylic and diazosalylic acid (the latter being an anthranilic derivative) yield compounds which are isomeric with the preceding, and very much resemble it in properties. Diazodiacylimide melts at 185°. Diazosalylimide is rather soluble in hot water, from which it crystallises in long needles, which sublime at 100°, and fuse at 145°.

Diazonisic and diazohippuric acid, if converted into perbromides and treated with ammonia, yield also the corresponding imides.

* 'Zeit. Chem.' (1867), 164.

Researches on the Chemical Composition of the Gases emitted by the Volcano of Santorin, from the 8th of March to the 26th of May, 1866.* *By* M. Fouqué.

The eruption of Santorin in 1866 was especially remarkable for the abundance and the nature of the gases which accompanied the emission of lava. The isolation of the eruptive centre in the midst of the sea prevented the access of air to the interior of the volcano, and thus enabled the combustible gases, which are usually burnt and destroyed by the oxygen with which they become mixed at high temperatures, to reach the surface without much alteration, their complete combustion taking place only where they issued into the air at certain highly heated points. Hence arose the jets of flame, which, for more than two months, continued to burn at the surface of small craters in the new formation, and the issues of gas bubbling through the sea-water and taking fire on coming in contact with the blocks of red-hot lava. So large a quantity of combustible gases had never before been observed in a volcanic eruption; indeed, with the exception of the bluish lights arising from the combustion of sulphur and hydric sulphide, no true flame had ever been proved to issue from a volcano.

The exceptional circumstances of the Santorin eruption have rendered it possible to collect the combustible gases in their unaltered state, as they issued from the depths of the ground at points where the temperature was not high enough to set fire to them on coming in contact with the air.

The greater portion of these gases was collected at the surface of the water, either round newly formed islands, or at the bottom of fissures with which the ground at Néa-Kamméni was penetrated, in the space between the two principal centres of action, Georges and Aphroessa; some of the gases, however, were collected when they issued into the open air on the sides of the Georges cone, or at points near the ancient formation of Néa-Kamméni; these were always mixed with a considerable proportion of atmospheric air.

Some of the gases were collected during the month of March, while the flames showed themselves abundantly throughout the field of eruption; the rest two months later, when the flames had nearly disappeared.

The following table exhibits the results of the analysis of these gases:

* 'Comptes rendus,' lxiv, 184 (28 Jan., 1867).

Gases collected at the surface of the water March 17, 1866.

	No. 1. In the most southern fissure of the ancient soil of Néa-Kamméni, between Georges and Aphroessa, at the surface of highly sulphuretted water, having a temperature of 73°.	No. 2. In the middle fissure of the ancient soil of Néa-Kamméni, between Georges and Aphroessa, at the surface of a highly sulphuretted water, having a temperature of 75°.	No. 3. In the most northern fissure of the ancient soil of Néa-Kamméni, between Georges and Aphroessa, at the surface of a highly sulphuretted water, having a temperature of 78°.	No. 4. In the channel between Aphroessa and the S.W. point of Néa-Kamméni, at the surface of the water rendered milky by the decomposition of sulphydric acid. Temperature = 61°.
Sulphydric acid . .	traces	traces	traces	traces
Carbonic dioxide .	37·04	37·24	36·42	35·60
Hydrogen .	27·10	28·12	29·43	30·09
Marsh gas .	0·43	0·47	0·86	0·81
Oxygen .	0·41	0·51	0·32	1·46
Nitrogen .	35·02	33·66	32·97	32·04
	100·00	100·00	100·00	100·00

Gases collected at the surface of the sea.

	No. 5. 13 March, 1866.—Near the northern shore of Aphroessa. Water rendered milky by decomposition of sulphydric acid. Temperature very variable, equal to about 60° at the surface of the sea, and scarcely exceeding 20° at a small depth.	No. 6. 10 March, 1866.— Around the islet of Reka. Water slightly milky from decomposition of sulphydric acid. Temperature very variable, from 50° to 60° at the surface of the sea and scarcely exceeding 20° at the depth of a few decimètres.	No. 7. 18 March, 1866.—Near the shore of Palæa-Kamméni, in the small port of Saint-Nikolas. Water of the sea not sulphuretted. Temperature = 19°. N.B.—This disengagement of gas took place before the commencement of the actual eruption.
Sulphydric acid . .	traces	traces	traces
Carbonic dioxide. .	0·07	1·49	78·44
Hydrogen*. . .	1·62	0·00	0·00
Marsh gas . . .	0·71	0·42	0·64
Oxygen . . .	21·56	18·45	3·37
Nitrogen . . .	76·04	79·64	17·55
	100·00	100·00	100·00

* The marsh gas predominates greatly in this mixture, which contains but traces of hydrogen.

	No. 8. 25th March, 1866.—In the most northern fissure of Néa-Kamméni. Water highly sulphuretted. Temperature = 69°.	No. 9. 25 March, 1866.—In the open air, on the western flank of Georges, at a point covered with a thick deposit of sulphur. Temperature = 160°.
Sulphydric acid .	traces	traces
Carbonic dioxide	50·41	1·64
Hydrogen . .	16·12	17·28*
Marsh gas . .	2·95	0·49*
Oxygen . .	0·20	14·12
Nitrogen . .	30·32	66·47
	100·00	100·00

Gases collected at the surface of the water.

	No. 10. May 4.—At the bottom of a fissure of Néa-Kamméni (probably that from which the gas No. 3 was collected). Water sulphurous. Temperature = 65°.	No. 11. May 4.—At the bottom of a fissure of Néa-Kamméni (perhaps the middle). Water sulphurous. Temperature = 56°.	No. 12. May 4.—Pond of water; remains of the channel between Aphroessa and Néa-Kamméni. Water sulphurous. Temperature about = 50°.	No. 13. May 12.—The same pond as in No. 12. Water exhibiting the same characters.
Sulphydric acid .	traces	traces	traces	traces
Carbonic dioxide .	90·78	95·37	86·76	84·85
Oxygen .	0·88	0·49	2·01	2·31
Nitrogen .	8·34	4·14	11·23	12·84
	100·00	100·00	100·00	100·00

Gas collected, May 12, at the foot of the Georges cone, on the base of the Néa-Kamméni cone.

	No. 14. Small sulphurous fumarole surrounded by crystals of octohedral sulphur at the level of the orifices; $t = 87°$.	No. 15. Small sulphurous fumarole, surrounded by a deposit of sulphur, partly melted, partly crystallised; $t = 122°$.
Sulphydric acid†	0.42	0·90
Carbonic dioxide	5·88	12·24
Oxygen . .	18·99	16·41
Nitrogen . .	74·71	70·45
	100·00	100·00

† In the Nos. 9, 14, and 15, the sulphydric acid determination was made on the spot, so that it is not so accurate as that of the other gases in the same mixtures.

The last six gases exhibited only traces of hydrogen or carburetted hydrogen.

The gases Nos. 9, 14, and 15 were accompanied at the moment of emission by a considerable quantity of aqueous vapour. This water, when condensed, was strongly acid, and after addition of nitric acid gave a copious precipitate with nitrate of silver, less abundant with chloride of barium. Before the addition of nitric acid, it blackened paper moistened with acetate of lead. Four cubic centimetres of water condensed at the place of emission of the gas No. 9 yielded, after addition of nitric acid, 9 milligrammes of chlorhydric and 2 milligrammes of sulphuric acid. The same quantity of water condensed at the place of emission of the gas No. 14, yielded, in like manner, 3 milligrammes of chlorhydric and 1 milligramme of sulphuric acid.

Conclusions:—1. The preceding results show clearly the important part played by hydrogen in the eruption of Santorin, inasmuch as the gaseous mixtures emanating from points nearest to the centres of eruption contained about 30 per cent. of this gas.

2. The proportions of hydrogen and marsh gas simultaneously evolved at different parts of the field of eruption corroborate the inference drawn by the author a year ago, from the examination of the gases evolved from the secondary vents of Vesuvius and Etna, viz. that the predominance of hydrogen indicates a degree of volcanic activity higher than when carburetted hydrogen predominates. In fact, in the central parts of the eruption, at the bottom of the fissures comprised between the two principal volcanic centres, the proportion of hydrogen rose on the 17th of March to 29·43 per cent. Nearer one of the centres (Aphroessa), and on the same line, there was evolved on the same day a gas containing 30·09 per cent. hydrogen.

On leaving the principal fissure of the eruption the proportion of hydrogen continually diminishes as the distance increases, at the same time that the proportions of marsh gas and carbonic dioxide increase; and in the gas collected in the neighbourhood of Réka and of Palæa-Kamméni the hydrogen is altogether wanting, while marsh gas and carbonic dioxide are present in considerable quantity.

Lastly, as the violence of the eruption diminished with time, changes of the same order were observed in the nature of the gases exhaled at any particular point. Thus, in the most northern fissure of Néa-Kamméni, on the 17th of March, the temperature of the water was 78°, and the gas contained 29·43 per cent. hydrogen and 0·85 marsh gas; whereas, on the 25th of March, when the temperature of the water was reduced to 69°, the evolved gas contained 16·12 hydrogen and 2·95 marsh gas; and on the 4th of May, in a fissure apparently the same as the preceding, but modified by the movements of the ground, the temperature was 65°, and the gaseous mixture no longer contained any combustible gases, but a large proportion of carbonic dioxide.

The observations made on the gases evolved at the bottom of the fissures of Néa-Kamméni, in the central part of the eruption, are the more valuable, as these gases were exhaled through a small mass of water having only an indirect communication with the sea, so that the composition and temperature of the gas could not be much altered by its passage through the water.

3. Notwithstanding the imperfection of the process for estimating sulphydric acid, the analyses 9, 14, and 15 show that the proportion of this gas diminishes as the temperature becomes lower.

4. Although the emanations of sulphydric and sulphurous acids were very abundant throughout the whole course of the eruption, the results above cited show that the chlorhydric acid was always in excess with regard to the acids of sulphur.

In a letter to M. Ch. Sainte-Claire Deville, dated March 5, 1867,* M. Fouqué stated that the eruption of Santorin still continued with unabated violence, the lava running incessantly into the sea in five different directions. Flame was still emitted from the summit of Georges, but not elsewhere.

On the Action of Potassic Permanganate on Hydric Peroxide. By L. Swiontkowski.†

If a freshly prepared aqueous solution of chemically pure potassic permanganate be mixed with one of hydric peroxide, which contains no acid, a brisk evolution of oxygen takes place, and the liquid assumes a deep coffee-brown colour. No precipitation ensues, even after long standing. Yet the solution (which has now become alkaline) is very unstable in its nature; on addition of any mineral acid, of potassic hydrate, argentic nitrate, and many other salts, and even of alcohol or ether, or by evaporation in vacuo or at 100°, a gelatinous precipitate is thrown down. By conducting the experiment under varied conditions, it appears that the precipitate is a mixture of quantities which are not constant of manganic oxide and peroxide, and that the relative amounts of these, when acidulated solutions of hydric peroxide are employed, depend on the concentration and acidity of such solutions. When the hydric peroxide is free from acid, the proportion between the products of decomposition of the permanganate depends both on the quantity of hydric peroxide added and on the treatment (evaporation, etc.) to which the brown solution is submitted.

It seems probable that when hydric peroxide is added to a solution of potassic permanganate the latter is first transformed into potassic di-manganate, and that further decomposition only ensues when the whole of the permanganic is changed into manganic acid. In fact, if hydric peroxide be gradually added to the permanganate until, on acidulating a sample of the mixture, the liquid above the precipitate is colourless, a solution is obtained which gives precipitates with several reagents, one of which is argentic nitrate; and an analysis of this precipitate shows that it not improbably consists, for the most part, of argentic di-manganate.

The next stage in the reduction consists in the con-

* Comptes rendus, lxiv, 666 (25 Mars., 1867).
† 'Ann. Ch. Pharm.,' cxli, 205.

version of potassic di-manganate into potassic hydrate, and the soluble modifications of manganic oxide and peroxide.

On the Stassfurt Method of Potash Determination. By T. Becker.*

The above is a modification of the method of Röllner and Mohr, and is due to Dr. A. Frank; it has been employed for several years in the Stassfurt and other works to determine the value of commercial chloride of potassium. 3·76 grm. of the sample, which always contains sodic chloride as an impurity, are dissolved with the aid of heat in 50—60 c.c. of a saturated solution of cream of tartar. For every 10 per cent. of the estimated amount in the sample dissolve 1 grm. of finely powdered bitartrate of soda in another 50—60 c.c. of the solution of tartar, and mix the two liquids. The entire solution is then to be cooled in a flask to the temperature of the saturated solution of tartar; the flask must be well shaken, and the precipitate allowed to subside. The mother-liquid is drawn off through a tube which contains a plug of cotton wool, and the precipitate is washed thrice with about 10 c.c. of the solution of tartar, the washings being removed through the same tube as the mother-liquid. Finally, the precipitate is dissolved in water, and normal soda solution added; the number of c.c. employed, multiplied by two, gives the percentage of chloride required. This method is said to yield accurate results and to be so expeditious as to enable the operator to make from ten to fifteen determinations in a day.

* 'Ding. Polytech. Journ.,' clxxxiii, 40.

VARIA.

In the correspondence of the 'Chemical News' of last week a writer who signs himself D. F., referring to a passage in the report of our special correspondent at the Paris Exhibition, states that the inhabitants of the rainless region of the Pacific coast of South America have for many years derived their supply of potable water from the sea-water of the Pacific, distilled in greater part by coal imported from England. It is singular that this comment upon Mr. Quin's report contains no reference to the journal in which it appeared. One would almost suspect that the letter of D. F. was intended for our columns, and that it owes its appearance in the 'Chemical News' to a pure mistake.

Mr. Thomas Harvey has retired from the firm of "Harvey, Reynolds, and Co.," opticians, photographic chemists, and dealers in scientific apparatus. at 10, Briggate, Leeds, as well as from that of "Harvey and Reynolds," pharmaceutical chemists, at 13, Briggate. Both businesses will be carried on as heretofore by the remaining partner, Mr. Richard Reynolds.

The office of Curator of the Museums of the Pharmaceutical Society of Great Britain is vacant, and the Council of the Society are prepared to receive applications from gentlemen desirous of filling it. A practical knowledge of chemistry, materia medica, and botany, is indispensable. Salary, £100 per annum. Applications, with testimonials, must be sent in on or before August 12. Full particulars of the duties may be obtained from the Secretary, Mr. Bremridge, 17, Bloomsbury Square.

A general meeting of the Aeronautical Society of Great Britain was held on Monday last, at the Society of Arts.

The Committee of University College Hospital require a Secretary, one of whose principal duties will be to endeavour to improve the financial resources of the hospital.

The business of scientific bookselling, publishing, and importing, carried on with so much success by the late Mr. Hippolyte Ballière, of 219, Regent Street, London, is for sale.

Mr. J. C. Stevens will sell by auction, on Thursday and Friday next (July 25 and 26) an optician's stock of telescopes, microscopes, etc.

An 'Introduction to Pharmaceutical Chemistry,' by Dr. Attfield, Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, is in the press.

An important volume, entitled, 'Comparisons of the Standards of Length of England, France, Belgium, Prussia, Russia, India, Australia, made at the Ordnance Survey Office, Southampton,' has been produced by Capt. A. R. Clarke, under the direction of Col. Sir Henry James. The publishers are Eyre and Spottiswoode.

By advertisement in the daily journals, "a gentleman who has lately recovered from a serious illness" has declared his readiness to pay the munificent reward of £2000 to any person who, between the present time and the 1st of July, 1868, shall discover a mode of *permanently* and completely extinguishing pain in all, or nearly all cases; the said means being "effectual, harmless, cheap, and easy to apply." Should no such discovery be made, £1000 will be given as awards to such persons as shall have made "discoveries of minor importance, but yet of great service in the relief of pain."

Dr. E. Symes Thompson has been elected Professor of Medicine in the Gresham College. According to the 'Lancet,' the new professor intends to make his lectures on physic, which will commence in Michaelmas term, of some use, by dealing with questions of sanitary science and hygiene in a semi-popular style.

The 'Lancet' states that Dr. Miller, F.R.S., is to be put forward tentatively as the selected candidate of the Liberal Conservative party of the University of London.

From the same journal we learn that the University of London will in all probability take up its temporary abode at 17, Savile Row, until its new building is completed. Building operations will be recommenced at once, and it is believed that it will be possible to hold the examinations next summer in the new structure, though the "offices" of the University will probably not be completed till a much later date.

The Council of the Institution of Civil Engineers have awarded the following premiums for papers read at the meetings during the past session:—A Telford Medal and a Telford Premium, in books, to J. T. Chance, M.A., for his paper "On Optical Apparatus used in Lighthouses," and to E. Byrne, for his paper, "Experiments on the Removal of Organic and Inorganic Substances in Water,'—A Telford Medal to G. B. Airy, Astronomer Royal, for his paper "On the Use of the Suspension Bridge with Stiffened Roadway for Railway and other Bridges of Great Span,"—A Watt Medal to Col. Sir W. T. Denison, R.E., for his paper "On the Suez Canal," — Watt Medal and a Telford Premium, in books, to J. Bourne, for his paper "On Ships of War,"—A Telford Premium, in books, to Capt. H. W. Tyler, for his paper "On the Working of Steep Gradients and Sharp Curves on Railways,"—to W. H. Preece, for his paper "On the Best Means of Communicating between the Passengers, Guards, and Drivers of Trains in Motion," and to W. A. Brooks, for his paper "On the River Tyne,"—The Manby Premium, in books, to C. D. Fox, for his paper "On Light Railways in Norway, India, and Queensland."

Mr. Byrne's investigation on the action of charcoal in removing the organic and inorganic matters from spring and river water, referred to in the last paragraph, was conducted in the laboratory of the Museum of Irish Industry. The results arrived at were detailed in this journal of June 1.

Publications Received.—'Annuaire de l'Académie Royale de Belgique,' 1867. 'Bulletin de l'Académie Royale de Belgique,' Nos. 5, 6. 'Moniteur Scientifique, Quesneville,' No. 253. 'Scientific American.' 'Chemical News.' 'Dublin Medical Press and Circular.' 'Reports of Royal Institution.'

Communications Received.—R. D. Silva; W. S. Jevons; A. Oppenheim; G. C. Foster; J. E. Howard; R. Galloway; E. M. Dingler; A. W. Hofmann; H. McLeod; R. H. Smith; W. M. Watts; J. A. Wanklyn; M. Foster; C. W. Quin; C. R. C. Tichborne; E. T. Chapman; A. Matthiessen; H. Watts; F. S. Barff; C. Hockin; J. A. Dana.

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journale und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

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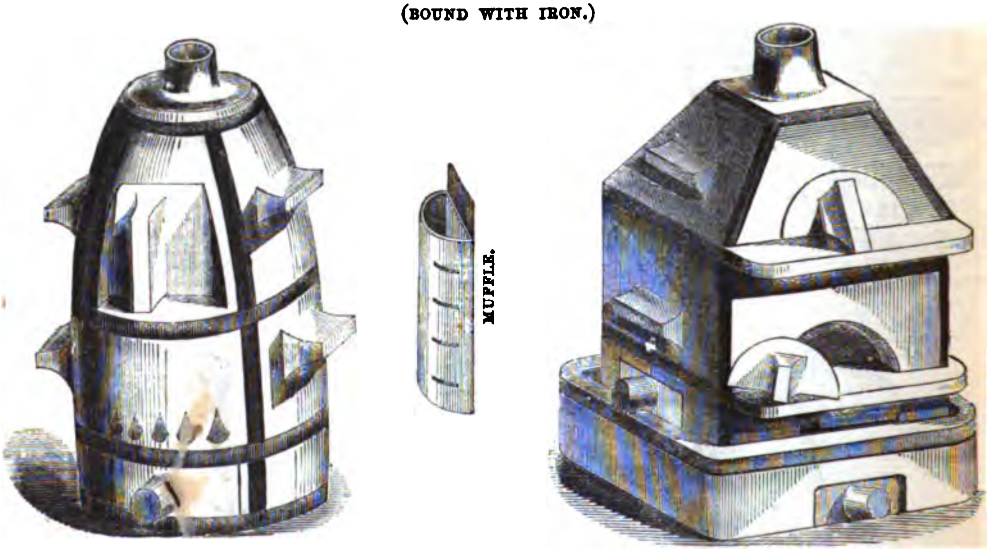

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CONTENTS.

TO THE

MEMBERS

OF THE

UNIVERSITY OF LONDON.

LONDON; *July*, 1867.

GENTLEMEN,—We beg leave to place before you the name of Sir JOHN LUBBOCK, Bart., F.R.S., as that of a gentleman eminently fitted to represent the University of London in Parliament.

The University of London is publicly recognised as embodying certain distinct principles; and it is obviously incumbent upon us to choose as our Representative a man whose known opinions are a guarantee that he will uphold those principles, and who also possesses sufficient ability and influence to aid materially in their advancement.

The main function of our University being to promote liberal and scientific education apart from all consideration of religious questions and other restricting influences, its political action must, as a necessary consequence, be particularly directed to the removal of all civil disabilities incurred on account of religious belief, to the vigorous development of national education on a broad basis, and to the active encouragement of science as an important element of general culture and an essential condition of national prosperity.

Sir JOHN LUBBOCK takes the warmest interest in all these objects, and would bring to the furtherance of them in the House of Commons the same zeal and energy which he is well known to have devoted to them without its walls. He moreover possesses unusual qualifications for their successful advocacy; for, while his intellectual and scientific eminence would give weight to his words on questions of science, of education, and of civil polity, his position in the City of London and his reputation as a man of business would obtain for him a hearing that might be denied to any one more exclusively occupied in scientific pursuits. For the same reasons he is peculiarly fitted to be the spokesman in the House of Commons of the large and increasing body of scientific men—a class whose opinions have hitherto found very inadequate expression in Parliament. This position, it need hardly be said, the public would naturally look to the representative of the University of London to occupy; and we have conclusive evidence that it would be difficult to find any one who would fill it so completely to the satisfaction of the leading scientific men of the country as Sir JOHN LUBBOCK.

The claims and wishes of the medical profession, with which our University is so closely and honorably connected, he fully appreciates and understands (indeed, so eminent a cultivator of Biological Science could hardly do otherwise), and he would be able to press them upon the attention of the country unhampered by the disadvantage of being regarded as a professional advocate.

On all general political questions he is well known to be an earnest and thorough Liberal, and, at the last general election, he obtained the hearty support of the whole Liberal party in West Kent.

Although Sir JOHN LUBBOCK is not a Graduate of our University (or of any other), he is closely identified with it, both by his own position as a Member of the Senate, and by the fact of his father having been one of the original Fellows and the first Vice-Chancellor.

G. CAREY FOSTER, B.A.,
WM. ODLING, M.B., F.R.S.,
On behalf of the Provisional Committee.

R. C. C. Lippincott.
A. F. Marreco, F.C.S.
A. Matthiessen, Ph.D., F.R.S., F.C.S.
E. J. Mills, D.Sc., F.C.S.
A. Naquet (Paris).
A. Oppenheim, Ph.D. (Paris).
W. H. Perkin, F.R.S., F.C.S.
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Maxwell Simpson, M.D., F.R.S., F.C.S.
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Henry Watts, B.A., F.R.S., F.C.S.
W. M. Watts, D.Sc., F.C.S.
C. Greville Williams, F.R.S., F.C.S.
J. A. Windham.
Adolphe Wurtz, F.R.S. (Paris).

Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzo-salicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *On Chlorophyll*, by Mr. Tichborne; *On a New Form of Sand Battery*, by Father Secchi; *On Brodie's Chemical Symbols*, by Mr. W. S. Jevons; *On a Method of Determining Vapour-Densities*, by Dr. Watts; *On London Waters*, by Messrs. Wanklyn, Chapman, and Smith; *Calculus of Chemical Operations*, by Sir B. C. Brodie; *On Affinity and Electricity*, by M. Georges Salet; *On the Destruction of Hyposulphites in Photographic Prints*, by Mr. Tichborne; *On Fruit Essences*, by Mr. H. N. Draper; *On "Violet de Paris,"* by M. Lauth; *On a New Form of Condenser*, by Mr. Barff; *Geber*, an Historical Study.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise Editorial Articles, Critical Reviews of Books, practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

*** Subscribers may materially assist in promoting the success of THE LABORATORY by bringing it under the notice of all their scientific friends.

The terms of Subscription are given in the next column.

UNIVERSITY OF LONDON.

FIRST B.Sc., AND PRELIMINARY SCIENTIFIC M.B. PASS EXAMINATIONS.—1867.

Wednesday, July 17.—Afternoon, 3 to 6.

NATURAL PHILOSOPHY.

Examiners.—Prof. Clifton, M.A., and Prof. Stokes, D.C.L., Sec. R.S.

1. Describe the construction of Harrison's "Gridiron Pendulum;" and explain how the effect of expansion is neutralised by it. If such a pendulum were to be constructed of copper aud platinum, having respectively the coefficients of expansion 0·000017 and 0·0000085, how many bars of each metal would be required, the mass of the bars being neglected in comparison with that of the bob?

2. Describe the method of determining the specific heat of a liquid, known as the method of cooling, and explain the principles on which the method is based.

Equal volumes of alcohol and water cool under the same circumstances through the same number of degrees in 2 min. 27 sec., and 5 min. respectively. What is the specific heat of alcohol, its specific gravity being assumed constant throughout the cooling, and equal to 0·81?

3. Describe experiments showing that radiant heat obeys the same laws of reflection as light.

4. Describe experiments showing that the free electricity in a charged body is entirely upon the surface. How is this phenomenon explained?

5. Two Leyden jars, one charged and one empty, are placed a little distance apart on a tray, and a wire is allowed to drop on the two knobs. Explain what would happen supposing the tray made (1) of glass, and (2) of metal?

6. What is meant by an "astatic" combination of two magnetic needles? Explain the arrangement of such a combination in a galvanometer, and the theory of the action of the instrument in so far as it differs from an ordinary galvanometer.

7. What is meant by electrical resistance? What circumstances in regard to a wire must be known before its resistance can be estimated? And what is the relation between the resistance and these circumstances?

The poles of a thermo-electric pile are connected by two copper wires, one being 10 feet long and $\frac{1}{20}$th of an inch in diameter, the other 15 feet long and $\frac{1}{10}$th of an inch in diameter. What is the intensity of the current in each of these wires, that which would pass in the thinner wire, if the other were removed, being taken as unity?

8. Describe the construction of a "relay," and show how by means of it a local battery may be put in action by a person operating at a distance.

9. Explain how "keepers" serve to maintain the magnetism of permanent magnets.

10. Define the terms (as applied to the earth), "Magnetic Meridian," "Magnetic Equator," "Magnetic Pole." How would a ship's compasses behave in the neighbourhood of a magnetic pole.

Wednesday, July 17.—Morning, 10 to 1.

MECHANICAL PHILOSOPHY.

Examiners.—Prof. Clifton, M.A., and Prof. Stokes, D.C.L., Sec. R.S.

1. A man, in the act of being weighed in a balance of the ordinary kind, pushes with a walking-stick the beam of a balance at a point between the point of suspension of the scale in which he is and the fulcrum. What effect, if any, will be produced on his apparent weight? If the scale in which the man is be kept from moving laterally by a horizontal string attached to a fixed point, what will be the effect?

2. When there is equilibrium in that system of pulleys in which one end of the string passing round each pulley is attached to a fixed support, and the system is displaced, show that the power is to the weight as the space through which the weight is lifted is to the space through which the power is moved, the weight of the pulleys being neglected.

3. A parallelogram is divided along a diagonal; and one half remaining fixed, the other half is lifted, reversed, and applied to the former half along the same diagonal. Find the distance between the centres of gravity of the quadrilateral figure thus formed and of the original parallelogram.

4. Define the mass of a body, and describe an experiment which shows that the masses of bodies are proportional to their weights, giving fully the steps of the argument.

5. An equilateral triangle is placed with one side vertical, and two equal masses, connected by a slack inelastic string, which passes without friction over the upper corner, are allowed to fall from the upper angle, the first down the slant side, the second down the vertical side. What start in time must be given to the first mass, that when the string is pulled tight the masses may destroy each other's velocity?

6. Describe an experiment in verification of the assertion that the surface of a heavy fluid at rest is a horizontal plane, and explain the steps by which the conclusion is arrived at.

7. When a body is floating partly immersed in a liquid, what effect will a fall in the barometer have upon the body? A cylinder floats in water with its axis vertical and two thirds immersed when the height of the barometer is 30 inches. What change will be produced when the barometer falls to 28 inches in a volume of water weighing 800 times the weight of an equal volume of air when the barometer stands at 30 inches?

8. Describe the hydrostatic press, and the method of packing the pistons. What is the mechanical advantage of this machine?

9. Give a geometrical construction for determining the geometrical focus of a small pencil of light proceeding from a given point and reflected directly at a given concave mirror.

10. A landscape is viewed through a simple astronomical telescope. What effect would be produced by holding your finger immediately in front of the object-glass, so as to cover part of it? Would the effect be the same in the case of a Galileo's telescope?

FIRST B.SC., AND PRELIMINARY M.B. EXAMINATION FOR HONOURS.—1867.

Tuesday, July 30.—Morning, 10 *to* 1.

CHEMISTRY.

Examiners—Dr. Debus, F.R.S., and Prof. A. W. Williamson, Ph.D., F.R.S.

1. Describe how you would accurately determine the amount of oxygen and hydrogen in water.

2. How would you prove, experimentally, that two volumes of hydrochloric acid are composed of one volume of chlorine and one volume of hydrogen,—two volumes of steam of one volume of oxygen and two volumes of hydrogen,—and two volumes of ammonia of one volume of nitrogen and three of hydrogen?

3. Describe Grove's galvanic battery; and explain the chemical process which takes place in the cells of the battery, and in a voltameter filled with cupric sulphate, and placed in the path of the current.

4. Explain the chemical action of chlorine on the hydrate of calcic oxide. What chemical changes occur when you boil an aqueous solution of bleaching powder? In what manner is bleaching powder acted on by atmospheric air and aqueous hydrochloric acid respectively?

5. Contrast the chemical properties of chlorine with those of fluorine. Show in what respects both elements agree, and wherein they differ.

6. Nitric acid is called a monobasic, sulphuric acid, a dibasic, and phosphoric acid a tribasic acid: enumerate the properties of these acids on which this distinction is founded.

FIRST M.B. PASS EXAMINATION.—1867.

Tuesday, July 30—Morning, 10 *to* 1.

ORGANIC CHEMISTRY.

Examiners.—Dr. Debus, F.R.S., and Prof. A. W. Williamson, Ph.D., F.R.S.

1. Enumerate the elements which occur in native organic bodies. Which element is present in all organic substances? What change takes place when organic bodies are made red hot in presence of oxygen?

2. Calculate the per-centage composition of a volatile body represented by the formula CH_4O. Give the density of the vapour of this substance.

3. How would you prepare pure prussic acid? Describe the most important chemical properties of this compound, and state your views respecting its chemical constitution.

4. Describe the chemical properties which characterise the members of the same homologous series; and illustrate your description by examples.

5. Enumerate the substances which are formed by the gradual oxidation of ethylic alcohol; and describe the chemical character of each substance thus produced.

6. Describe the leading chemical properties of starch. How may starch be converted into dextrine and sugar respectively? Explain the decomposition of the latter in the process of fermentation.

The following are Lists of Candidates who passed the respective examinations indicated:—

FIRST B.SC. EXAMINATION.

First Division.

	Colleges, etc.
Bottomley, James, B.A....	Owens College.
Carey, Francis James, M.A.	Guy's Hospital.
Gunn, William	Private study.
Harding, Percy John......	University College.
Hopkinson, John	Owens College.
Robinson, Arthur	Owens College.
Tilden, William Augustus	Private study.
Wormell, Richard, M.A....	University College.

Second Division.

Ball, James Barry..........	University College.
Brice, Seward William, B.A.	Royal School of Mines.
Bright, John Albert	University College.
Graham, John Cameron...	University College.
Leonard, Rev. Frederick, M.A., LL.B.	Baptist Bristol, and University.
Pearsall, Henry Mander, B.A.	New and University Colleges.
Sheldon, Charles, B.A. ...	Owens College.
Thorp, William	Royal School of Mines.
Whipple, George Mathews	Private tuition.

PRELIMINARY SCIENTIFIC M.B. EXAMINATION.

First Division.

	Colleges, etc.
Aveling, Edward Bibbins	Private study.
Ball, James Barry	University Coll. Hospital.
*Barff, Frederick Settle (Student before 1839).	University College.
Bruce, John Mitchell, M.A. Aberdeen.	University of Aberdeen.
Burn, William Barnett ...	St. Bartholomew's Hospl.
Carter, Charles Henry ...	University College.
Elkington, Ernest Alfred	Sydenham C., Birminghm.
Gibbings, Alfred Thomas	King's College.
Harris, James Alfred......	University of Edinburgh.
Harris, Michael	Guy's Hospital.
Haynes, Horace Eyre......	St. Bartholomew's Hospl.
Hunt, Thomas Henry ...	Manchester R. Sc. of Med.
Saunders, Arthur Richard	University College.
Wall, Alfred John	St. Mary's Hospital.

Second Division.

Bindley, Philip Henry ...	Sydenham Coll., Birm.
Burgess, Wm. Frederick Richardson.	Guy's Hospital.
Carr, William Ward	University College.
Carter, Alfred Henry......	University College.
Cotterill, Alfred	King's College.
Coupland, Sidney	University College.
Cross, Francis Richardson	King's College.

* Chemistry and Botany only.

Second Division—continued.

	Colleges, etc.
DeMéric, Henry Eugène	King's College.
Edwards, John Ellis	Guy's Hospital.
Fox, Thomas Colcott	University College.
Franklin, George Cooper	St. Thomas's Hospital.
Graham, John Cameron...	University College.
Herman, George Ernest	London Hospital.
Ingoldby, Joseph Theodore	Guy's Hospital.
Jones, Thomas	Guy's Hospital.
Lowe, Walter George ...	St. Bartholomew's Hosp.
Lyell, Robert Wishart ...	King's College.
Male, Henry Davis	St. Thomas's Hospital.
Paget, William Smith ...	Liverpool Sch. of Medicine.
Perkins, Charles Edward Steele.	Guy's Hospital.
Pippette, Walter	Westminster Hospital.
Pughe, Rhinallt Navalw ap Joan.	Private study.
Ralli, Alexander Antonio	St. Bartholomew's Hosp.
Rayner, John Alexander	King's College.
Rowland, George Le Hunt	King's College.
Rugg, Baron Alfred	University College.
Simon, Maximilian Frank	St. Thomas's Hospital.
Sloman, Samuel George	St. Bartholomew's Hosp.
Smith, Arthur William...	Guy's Hospital.
Southee, Henry Edward	Private tuition.
Taunton, William Whitchurch.	University College.
Waddy, Henry Edward...	Guy's Hospital.
Willans, William Henry	University College.
Williams, William	Guy's Hospital.

One candidate, Lindsey Middleton Aspland, M.A., of University College, passed the LL.D examination. One hundred and thirty-three candidates passed the first B.A. examination; 74 in the first division, 57 in the second division, and 2 in first division excluding mathematics.

PARIS UNIVERSAL EXHIBITION.

FRANCE.—MINING AND METALLURGICAL PRODUCTS.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

Petin, Gaudet and Co.'s Exhibits—The Mine of St. Leon—The Chatillon and Commentry Company—Messrs. Schneider and Co.'s Works at Le Creusot—Carvès and Co.'s Coal Products—La Grand'Combe Company—The Anzin Company.

PARIS; *July* 30.

HAVING examined the mineral and metallurgical products exhibited in that portion of the building devoted to Class 40, we will proceed to give an account of those which are scattered about without apparently any kind of order, in the park, in the machinery department, and elsewhere. This method of arrangement may possibly be picturesque, but it is more than inconvenient to the visitor, who, after having looked at everything that is exhibited in the proper place, finds that he has still a number of objects of the greatest interest to study dotted about amongst theatres, glove shops, sugar-plum stalls, Bible repositories, and howling Arabs, in that wonderful mixture of Cremorne Gardens and Bartlemy Fair called by courtesy "the Park."

Entering the grounds from the Pont d'Jena by the grand entrance, we find on our right the shed in which Messrs. Petin, Gaudet, and Co. exhibit their splendid specimens of Bessemer and ordinary steel, in the raw and manufactured state. They are the largest makers of steel in France, and possess mines in Sardinia; charcoal smelting works at Toga in Corsica, at Clavières, l'Isle, and Bonneau (Indre); coke smelting furnaces at Givors, at the confluence of the Rhône and Gier; refineries and puddling furnaces at Toga, Vierzon, and Rive de Gier; refineries and rolling mills at St. Chamond, and steel works at Assailly. Of these latter the St. Chamond works are the most important. The works at Givors rank next, being within easy communication by canal and railway with the coal-basins of the Loire and Gier, as well as with the islands of Sardinia and Corsica by rail, river, and sea. The mine of St. Leon, in the island of Sardinia, yields large supplies of magnetic ore of the finest quality, resembling greatly in appearance and composition the far-famed magnetic ores of Sweden; it contains, however, a notable quantity of silica, as gangue, which reduces its value as an iron-yielding ore, although it does not interfere with its quality. The following analysis shows its worth as an ore peculiarly fitted for the Bessemer process:

Protoxide of iron ...	24·00
Peroxide of iron ...	62·00
Oxide of manganese	0·80
Lime	a trace
Magnesia	a trace
Sulphur	0·20
Phosphorus	0·00
Silica	13·00

The ore yields, on an average, 62 per cent. of metallic iron.

The mine of St. Leon is situated at the head of the torrent known as Sugutturu Mannu, and from trials made in all directions appears to contain an inexhaustible supply of the mineral. The ore is transported to La Maddalena, a little seaport on the western point of the Gulf of Cagliari, by a railway between nine and ten miles long, lately constructed by Messrs. Petin and Co. The number of miners, foremen, clerks, and managers, employed at the mine amount to nearly 300. The St. Leon mineral is not the only ore used; large quantities of pisolitic ore from St. Florent (Cher) and St. Aout (Indre), and a sinuous red hematite from Clavières, being also smelted at the various blast-furnaces belonging to the firm. The specimens of steel displayed by Messrs. Petin and Co. have excited the wonder and admiration of every one who has visited their show. One ingot, weighing 25,000 kilogrammes, especially deserves notice. This enormous mass of metal has been broken in two, to show the grain, and stands there in two halves, each of which is nearly six feet high. They also show armour-plates of the best

quality, as supplied to the French navy, which have come off victors in the great battle now raging between guns and plates. A plate sent over to Woolwich for trial astonished our Iron-plate Committee by its powers of resistance. The ⌶ and T steel girders shown are also of unusual breadth of section, and are another instance of the coming fulfilment of Dr. Percy's prophecy as to the future of steel. It would be impossible in the space at our disposal to describe all the articles exhibited in this magnificent display, which is unquestionably the finest show of steel ever seen. The number of workmen employed at the various establishments belonging to the firm is 6000, and their annual production is from forty to fifty millions of francs.

Quitting Messrs. Petin, Gaudet and Co.'s splendid display, and crossing the grand avenue, we shall find the shed belonging to the Chatillon and Commentry Company. Before entering it we may pause for a moment to admire the two magnificent fountains placed on each side of the avenue, one from the foundry of M. Durenne, the other from the works of M. Barbezat, his great rival. These two superb specimens of artistic metallurgy show clearly what art and science properly combined are capable of doing. Although colossal in their proportions, they are both covered with a coating of metallic copper by the electrotype process, which in turn has been bronzed. Round these are several cast-iron statues of great excellence treated in the same way. The works of the Chatillon and Commentry Company may be divided into two groups, one comprehending the mines, blast-furnaces, and rolling mills, situated in the departments of the Côte d'Or, Aube, and Haute Marne; the other comprehending the coal-mines, iron-mines, and blast-furnaces in Allier and Cher. Their show consists principally of wrought iron rolled into angle ⌶ and T girders, bars, rods, and plates. The ore used by them is principally the pisolitic variety from Berry, Burgundy, Morvan, and Champagne, also a poor calcareous ore, mixed with clay and silica, from Thostes. They likewise use the magnetic ore from Mokta-el-Hadid, in Algeria. One of their methods of treating powdery ore is, we believe, peculiar to them. The ore is mixed with certain proportions of clay and limestone, made into bricks in an ordinary brick-making machine, dried, and thrown into the blast-furnace with the richer ores. At the end of the shed is a kind of trophy, in the form of a half-size reduction of the Fontaine de Medicis in the Luxembourg Gardens, the whole being constructed of wrought iron. Two *repoussé* bas-reliefs, in wrought-iron plate, one representing a miner at work, the other a workman shaping a piece of iron at a steam-hammer, are of great merit, and form another instance of the applicability of iron to artistic purposes. The vertical and horizontal sections of the Bezenet coal-fields, worked by the company, show some very singular contortions of strata. They produce annually from 300,000 to 350,000 tons of coal and coke, nearly 70,000 of iron and steel of all kinds, and employ nearly 9000 workmen, who with their families form a population of over 20,000 souls supported by the company.

Passing out of the shed, and glancing for a moment at the splendid marble columns opposite to us exhibited by Messrs. Dervillé and Co., we again turn to the left and journey past the great French wrought-iron lighthouse, in search of a building in which are shown the productions of the Creusot Works, belonging to Messrs. Schneider and Co. It will be found close by the International Theatre. Le Creusot is undoubtedly one of the industrial wonders of the age, and as such deserves a somewhat extended notice at our hands.

Le Creusot is situated near Autun, in the department of the Saône et Loire, about 17 miles from this latter town, 25 from Chalon-sur-Saône, and 250 from Paris, on the Chagny and Nevers branch of the Lyons railway. It is about five or six miles from the Canal du Centre, which puts it into communication with the Atlantic Ocean and the Mediterranean.

In 1780 the only human habitations on the spot where Le Creusot now exists were a few huts, which, from being close to the place where several veins of coal cropped out from the surface, were known as Les Charbonnières. Towards 1781 a company under the name of Perrier, Beltinger, and Co., established themselves at Le Creusot for the purpose of working the coal and iron mines of the locality. Louis XVI was so impressed with the value of the project that he joined the firm as a private partner, and successfully introduced the casting of iron cannon into France. A few years later the gentle Marie Antoinette founded a glass works at Le Creusot, which existed under the name of the *Manufacture de la Reine* until 1832, when it was transferred to Baccarat. During both the Republic and the First Empire Le Creusot was extensively patronised by the government, but towards 1810 its prosperity began to wane, and in 1815 the works were discontinued. Three years later it was bought by MM. Chagot, who were so unsuccessful in their management that in 1826 they sold it to an English firm, Messrs. Manby and Wilson, who speedily followed in the footsteps of their predecessors, and became bankrupt in 1834. The works again lay fallow for three years, when Messrs. Schneider Brothers bought them up, and brought a large capital to bear upon their improvement, undismayed by the thousands of pounds already sunk in the undertaking. Since this period they have gone on increasing in prosperity and extent until they have reached a point unsurpassed by any similar establishment in the world. The following figures will give our readers an idea of the growth of Le Creusot during the last thirty years.

The mineral concessions cover an area of nearly 6 square miles, the coal fields 25 square miles, the buildings 296 acres. There are nearly 45 miles of railway between various parts of the works, upon which are constantly running 16 locomotives. The galleries in the mines are more than 20 miles long, and the number of workmen employed is only 50 short of 10,000, who carry on, without intermission, every operation connected with mining, metallurgy, and the manufacture of machinery of all kinds. In fact, the iron ore that comes in at one end of the works may be said to go out of them at the other

in the form of a finished locomotive or marine engine. At present the annual production of the iron mines of Change and Mazenay is above 300,000 tons, and of the coal mines at Le Creusot 250,000 tons, from which are smelted 130,000 tons of pig-iron. In 1837 the amount of pig-iron produced was only 4000 tons, the amount of coal 60,000 tons.

The ore employed at Le Creusot is principally an oolitic variety obtained from the mines of Mazenay, which are situated at about twenty-eight miles from the former place. The line between the two places runs over a part of the Lyons railway, a portion of this iron road being rented at so much per ton per kilometer to the proprietors of Le Creusot. Six heavy trains run backwards and forwards daily between the works and the mines. The mineral exists in a stratum five miles long by nearly three quarters of a mile broad, and varies in thickness from two to six feet. It is calculated that five millions of tons are yet unworked, Besides the Mazenay mineral, Le Creusot consumes enormous quantities of the pisiform ore from St. Florent (Cher), specular ore from Elba, and magnetic ore from Mokta-el-Hadid, in Algeria.

The building in the park is really quite an exhibition in itself, containing, as it does, specimens of everything that goes into or out of the works at Le Creusot, from the coal, ore, and limestone, to the finished marine engine of 3800 horse-power just constructed for "l'Océan" French ironclad.

On entering the building the first thing we have to examine is the contents of a large glass case on the left, consisting of specimens of the coal, coke, ore, and limestone, used in the production of the iron used at Le Creusot. The Mazenay mineral is a brown oolite, much mixed with calcareous gangue, and gives from 27 to 28 per cent. of metallic iron. The Mokta-el-Hadid ore yields from 62 to 65 per cent., the Elba ore from 58 to 60 per cent., and the St. Florent pisiform ore from 38 to 40 per cent. of pure metal. The coal used is peculiarly free from pyrites, and the coke manufactured from it contains but a very small percentage of sulphur, a fact which accounts for the Le Creusot iron being famous for its freedom from "hot shortness." Next to these we have samples of the different qualities of pig-iron, from No. 1, which in the refining produces a coarse iron fit for rails, &c., to No. 7, which is of a quality far surpassing our best English iron. Side by side with these are the various qualities of pig best adapted for castings. Corresponding with these are specimens of seven different qualities of wrought iron, both fibrous and homogeneous, displayed in every way that can show their particular excellences. The specimens of No. 7 are certainly wonderful, and almost seem to show that there are qualities of iron to be made in France that are equal to any in the world, not excepting even Sweden. Above the case are several interesting pieces of chemical apparatus. The first of these is an apparatus for the estimation of iron in ores. It is so arranged that the solutions of the ore are cooled in an atmosphere of carbonic acid, which always retains the iron in them at a minimum of oxidation. When cool they are titrated in the ordinary way by Margueritte's permanganate of potash process. There is also an apparatus for determining the amount of carbon in cast iron. The metal is reduced to a fine powder, mixed with oxide of copper and asbestos, and heated to redness, the amount of carbonic acid liberated being determined, in the usual way. There is also an apparatus for the analysis of coal-gas, but it does not offer any point of interest. These pieces of apparatus are placed too high up for close examination. The rest of the building is filled with marine engines, locomotives, stationary engines, hydraulic presses, blowing machines, steam-hammers, girders, and other objects which are rather beyond our province to describe. There are also large models of the mines and works, which are all made to scale in the most beautiful manner. Round the walls of the building are hung plans and sections of the mines, and a series of statistical tables showing the rise and progress of Le Creusot. We are strongly tempted to transcribe some of these statistics. Messrs. Schneider seem to have been all along thoroughly imbued with the notion that a miner or engine-fitter is something more than a mere machine. They give their workmen, not only "good measure," but the "running over" that is so rarely thought of nowadays. They have built for them two Roman Catholic churches and a Protestant chapel, boys' and girls' schools, a library, a hospital, and a dispensary. The town of Creusot, which contains 25,000 inhabitants, and is consequently the most populous in the department of the Saône et Loire, has been paved, lighted, and beautified by them in a way that would earn the approval even of M. Hausmann and they have not only founded a savings bank, where the workman gets 5 per cent. for his savings, but they have done all they could to induce their men to become the owners of the houses wherein they live. They have, as much as possible, abolished female labour in their works, knowing the evil influence such a system has upon female morality; in fact, they have left no means untried to render Le Creusot a truly happy valley, in which "rattening" is unknown, and whose inhabitants only understand the word "strike" in its original signification.

In a corner of the park, close to the Porte de l'Université, is a small building, containing a collective exhibition of coal from a number of companies who work the Loire coal-fields. It consists of specimens of coal and coke from different localities, several models of machines, cages, etc., and a series of sections and plans of the various coal-fields. Carvés and Co. add to the interest of their series of samples by showing specimens of nearly every product derived from coal. One large model, showing the mode of working by means of what are called *remblais complets,* or packings formed of blocks of sandstone, quarried and taken down for the purpose of supporting the roof, is extremely interesting. This system, which has been adopted all through the Loire district, is said to be most serviceable as a protection against spontaneous firing and loss of life from the falling of the strata above. The Loire coal-field, the centre of which is at St. Etienne, produces over 2,000,000 tons of coal per

annum, and is only rivalled in this respect by the Valenciennes district. Some of the seams near St. Etienne are forty feet thick.

La Grand'Combe Company, one of the largest in France, show a beautiful series of plans and sections in the French machinery department in the Exhibition building itself; also a model of the strata in which the mines are situated, nearly twenty feet square. This company raises nearly 600,000 tons per annum. Their head-quarters being situated at Alais, they are in easy communication with the Mediterranean ports, and supply the steamers trading to and from them with large quantities of coal, both for their own use and for exportation. They manufacture compressed fuel in large quantities, their production reaching nearly 70,000 tons a year.

On the walls of the machinery department the Anzin Company (Valenciennes) show a beautiful series of maps and sections. Below they show an immense number of specimens of coal, carefully described, and with their analyses appended. The Anzin Collieries are the largest in the world, producing no less than 1,200,000 tons per annum, and employing 8000 hands.

The machinery department is particularly rich in all kinds of mining machinery of the greatest interest, but the calls on our space for other subjects more closely connected with chemical science compel us to refrain from entering into any description of it.

LITERATURE.

HUNT'S URE'S DICTIONARY.

URE'S *Dictionary of Arts, Manufactures, and Mines. Edited by* ROBERT HUNT, *F.R.S., assisted by numerous Contributors eminent in Science and familiar with Manufactures.* Sixth Edition. In three volumes. London: Longmans, Green, and Co., 1867.

THE sixth edition of this well-known and very useful work contains a considerable amount of new and valuable information, especially relating to the new industries of the aniline dyes, the paraffin and petroleum oils, and a variety of new inventions connected with metallurgy and the working of mines. Coal-cutting machines, the Man-engine for relieving miners from the fatigue of ascending and descending, and Ansell's Fire-damp indicator, are fully described.

The articles 'Artillery' and 'Fire-arms' have been re-arranged, and much new matter added relating to breech-loading ordnance, the penetrating powers of various kinds of shot, and the resistance of armour-plates.

The articles 'Bleaching,' 'Calico-printing,' 'Cotton-spinning,' and others relating to textile manufactures—which, by their full descriptions and admirable graphic illustrations would alone suffice to stamp the work with a very high value—have been carefully revised and brought up to the present state of knowledge.

Great pains have also been bestowed on many of the articles relating to metals. Under 'Aluminium' we have a description of the mode of preparing this metal as carried on at the works of Mr. Lowthian Bell, of Newcastle; also an excellent article, written by that gentleman, on Aluminium-bronze. The article on 'Copper' is enriched by descriptions of several methods of utilising the "copper-smoke"—that is to say, the sulphurous vapours evolved in the roasting of copper-ores—for the manufacture of sulphuric acid; also of various methods of obtaining the copper from sulphur-ores containing small portions of that metal which have been burnt for the production of sulphuric acid.

Under 'Gold' we find a new and very interesting account of the gold mines of North Wales, and the modes of extraction there practised, including Mr Crookes's ingenious application of sodium and potassium to facilitate the amalgamation of the gold.

The excellent article on Iron, by Dr. Noad, is left nearly in the same state as in the former edition; the new method of puddling by machinery being treated in a separate article. In connection with this subject we must also notice the new description of Bessemer's process of making steel given in the third volume. Under 'Magnesium' the method of preparing that metal, invented by Deville and Caron, and modified by Sonstadt, and its use for producing a light possessing great chemical power, are satisfactorily described. The descriptions of the remaining metals are for the most part the same as in the former edition.

Under 'Electricity' we have a description of Abel's fuses for igniting charges of gunpowder by electric action; and to the original article on Electro-telegraphy by Mr. Walker, the editor has added an interesting description of the Atlantic cable.

Under 'Freezing' there is a short description of Carré's ice-making machine; this, we think, was deserving of a graphic illustration. A description and figure of Kirk's refrigerating apparatus used in Young's paraffin works would also have been a valuable addition to this article.

There are also new articles, or additions to former articles, on Boring, Cheese, Exports, Glycerin (Nitro-), Hydraulic Cements, Hydraulic Machinery for Mines, Manganates as Disinfectants, Murexide, etc.

After having noticed so many important additions to the Dictionary, it may appear somewhat invidious to speak of errors and omissions. Still, we should scarcely discharge our duty as critics if we neglected to do so, and moreover we think that by pointing out such as we have noticed, we may be doing good service for the improvement of future editions.

ACETYLENE.—This hydrocarbon being a constituent of coal-gas, a short article upon it should have been introduced.

ALLOYS.—Matthiessen's researches should certainly have been noticed.

ALUM, BASIC.—The formula of this salt was incorrectly given in the last edition, and the error is repeated in the present.

ATOMIC THEORY. ATOMIC WEIGHTS.—These articles appear to have done duty through several editions. They represent ideas now nearly obsolete, and should have been omitted or rewritten.

BREAD.—This article, written by the late Dr. Normandy, is left just as he wrote it, and accordingly Dr. Dauglish's method of making unfermented bread,

which has now for some years been successfully carried out on a large scale by the Aërated Bread Company, is spoken of as "a remarkable process which has lately excited some attention." It would have been worth while to insert a foot-note stating that this remark was written some years ago.

CARBOLIC ACID.—Calvert's process of manufacture should have been noticed; also the very important application lately made of this substance by Mr. Crookes, as a disinfectant in the case of the cattle plague.

COAL-GAS.—The excellent article by Dr. Frankland is left as in the last edition. An account of his recent researches on the conditions of luminosity in flame, and of the Rev. W. Bowditch's method of removing volatile sulphur-compounds, would have added greatly to its value.

COFFEE (vol. i, p. 845).—"Roasted coffee affords a much richer infusion to hot water containing a minute quantity of carbonate of soda, and improves the quality of the coffee on the stomach by neutralising the free acids." We would seriously recommend that this passage be translated into English for the next edition.

COKE.—The German synonyme given for this word is "Abgeschwefelte."

COLUMBIUM or NEOBIUM.—"A peculiar metal, extracted from a rare mineral brought from Haddam, in Connecticut. It is also called tantalium, from the mineral *tantalite* and *yttrotantalite*, found in Sweden." This statement of the identity of columbium and tantalum is altogether wrong. The error has been so often pointed out, and the distinction between the two metals has been so clearly demonstrated by the researches of Rose and of Marignac, that its repetition at the present day is inexcusable.

COMBINING NUMBERS.—"It is usual to call that number the *combining* number of any element which expresses the proportion in which it unites with one part by weight of hydrogen." According to this, the combining number of nitrogen should be $4\frac{2}{3}$, of carbon 3, etc. etc.

EQUIVALENTS, CHEMICAL.—The term equivalent in this article appears to be used synonymously with atomic weight, or combining proportion.

FERMENTATION.—Pasteur's important researches on this subject are not noticed.

FURNACE.—Under this head, some account of Siemens' regenerating furnaces might be looked for. We have not been able to find a description of them in any other part of the Dictionary.

GUNCOTTON. GUNPOWDER.—The space devoted to these manufactures is hardly commensurate with their importance. The recent experiments of Abel are but slightly noticed, and those of Bunsen, and Schischkoff, and Karolyi, are not mentioned at all. There are, however, some judicious observations on Mr. Gale's process for rendering gunpowder temporarily non-explosive.

GUTTA PERCHA.—Miller's experiments on the alteration of gutta percha by oxidation, etc., should have been noticed.

HYPOSULPHITES.—These salts are very imperfectly described. The use of sodic hyposulphite in photography is mentioned, but there is nothing about its use as an antichlore. Neither is there any mention of the method of preparing it on the large scale from soda-waste and gas-lime.

KREOSOTE or CREOSOTE.—The statement that creosote from wood-tar consists essentially of the same substances as the so-called coal-tar creosote—namely, phenol, $\text{C}_6\text{H}_6\text{O}$, and creosol, $\text{C}_7\text{H}_8\text{O}$—is not in accordance with the results of recent experiments. According to Hlasiwetz, wood-creosote consists mainly of an acid oil, $\text{C}_8\text{H}_{10}\text{O}_2$ (creosol), which is likewise contained in the product of the destructive distillation of guaiac resin.

METALS.—The number of known metals is stated to be forty-seven, and a list of them is given; but *cerium*, *lanthanum*, *didymium*, *tantalum*, and *ruthenium*, are omitted, and pelopium, which exists in name only, is still retained.

METHYLATED SPIRIT.—A fuller account of this mixture, and of the Excise regulations as to its sale and use, would, we should think, have been acceptable to many manufacturers.

"METHYLENE, a peculiar liquid compound of carbon and hydrogen extracted from pyroxilic spirit, which is reckoned to be a bihydrate of methylene." If the author of this statement has really succeeded in isolating methylene, let him at once communicate his results to the Royal or the Chemical Society; we will promise him undying fame.

NITRIC ACID.—There is no description of the modern methods of condensation.

OXALIC ACID.—Dale's process for preparing this acid by treating sawdust with caustic alkali is not even mentioned.

PLATINUM.—There is no description of Deville and Debray's method of treating platinum-ore and separating the several metals contained, or of their furnace for fusing platinum. It is true the methods adopted by these chemists for obtaining rhodium and ruthenium from *platinum-residues* are given under their respective heads; but the method of treating the ore itself, and especially the extraction of platinum from it, which is of much greater importance to manufacturers, should have been given under PLATINUM.

POTASH.—The manufacture of the carbonate and other salts of potash is very imperfectly treated; the extraction of these compounds from the ashes of marine plants, from sea-water, and brine-springs, from the salt-beds of the Stassfurt deposit, and from the ashes of beet-root obtained in the beet-root sugar manufacture—all processes which have lately risen into great importance—are altogether omitted.

POTASSIUM.—The method of obtaining this metal from the carbonate is described exactly as in former editions, with a figure of the old cylindrical condensers used by Brunner, which are well known to afford but very imperfect condensation; and there is nothing said about the flat receivers which were introduced by Mareska and Doury, and are now universally adopted in the preparation, not only of potassium, but of the more practically important metal, sodium.

SILICATES.—Under this head the application of soluble silicates to mural painting should have been noticed.

SOAP.—The article is left as in the last edition, so that there is no mention of Mr. Gossage's recent improvements in the preparation of silicated soaps.

STEAM-BOILERS.—"Space does not allow of our entering on a consideration of this important subject." The same apology was made in the last edition. We think that for so very important a matter, space should have been found.

SUGAR.—This article also remains as in the former edition, and contains no account of the modern improvements in the beet-sugar manufacture, so well described in the article "Zucker-fabrication" in the last volume of the 'Handwörterbuch der Chemie,' published in 1865.

TANTALUM.—The error already noticed about the identity of this metal with columbium is repeated under this head. The name of the discoverer of columbium is also printed wrong—*Hutchett*, instead of Hatchett.

We have now done with fault-finding, and we hope it will be understood that in pointing out the above errors and omissions, we have been actuated, not by a spirit of carping criticism, but by a wish to offer suggestions for the improvement of future editions of the Dictionary. Some of the errors which we have noticed relate to matters belonging rather to a dictionary of pure chemistry than to one devoted to arts and manufactures: still, if these matters find a place in the work, they should be given correctly. We could have given a longer list of errors of this class, were it not for the fear of being tedious, and of extending this notice to too great a length. Before, however, dismissing the subject, we cannot help expressing an opinion that rather too much space is given to articles of purely scientific interest, and that the curtailment of these in future editions would afford more space for some of the omitted matters more properly belonging to a dictionary of arts and manufactures. On the whole, however, we can congratulate the editor on the production of a truly valuable work, affording a clear and striking picture of the present state of manufacturing and mining industry.

EDITORIAL NOTES.

COLLEGIATE EDUCATION AND SCIENCE AND ART EXAMINATIONS.

IT has been remarked that chemists are not always so well educated as they might be in subjects somewhat out of the sphere of their special science. It is not our intention to consider whether this be true or not, and we merely refer to the assertion as a sign of the prevailing opinion as to the necessity of general education for rendering fully available particular knowledge, and of the increasing demand for a more comprehensive system which distinguishes the present educational movement.

Before a committee of the House of Commons the Dean of Christchurch, Oxford, lately gave as his opinion, and that of other influential members of the university, that every effort ought to be made to render the Oxford system large enough to meet present wants, and that medical and scientific studies should receive tangible encouragement, so as to induce students to avail themselves of the benefits of a collegiate education. This authoritative enunciation of Oxford, the recent appointment of a Lecturer on Chemistry and Physical Science at Trinity College, Cambridge, and the growing popularity of the Science Tripos, are satisfactory evidences of the working of the leaven of modern thought in both the ancient universities. The movement which has thus affected bodies eminently conservative and opposed to innovation, by loosening their deep-rooted prejudices must be sustained by the irresistible power of truth. "Magna est veritas et prævalebit."

In the new order of things, as in all reactions, there is some danger of running into extremes, and so extending the curriculum that education must be superficial and smattering, instead of sound learning the result. At present, however, we need not discuss the possible evils of an extravagant extension of the regular course of collegiate studies. The recognised authorities on education are only just beginning to perceive that their system is too narrow for modern requirements, and we have no reason to fear that they will enlarge it beyond safe limits.

We wish now to call attention to a sham educational system, in which general knowledge goes for nothing. This system is the invention of the managers of the Science and Art Department, whose audacious versatility recalls the oft-quoted remark of Sidney Smith upon Lord John Russell, that he would take command of the Channel Fleet or perform a difficult surgical operation at a moment's notice. They are ready for any work, from the carrying out of a scheme of national education to the building of a music-hall. In every respect unfitted to deal with so serious a subject, they have constituted themselves the head of a system of Science examinations, which has received the sanction of no learned body, and with the principles of which no one but themselves is acquainted. Men of business look with suspicion on an undertaking which has not for its directors those who command the confidence of the commercial community; and the first questions asked when a prospectus is issued are—Who are the directors? What

are the objects of the undertaking? and what the proposed means of carrying them out? Now, if such questions be put in the case of the South Kensington speculation, what must be the answer? We respect the worthy and amiable nobleman at its head, but we cannot admit that he is competent to frame a scheme of education; and, after him, there is not one who has the slightest pretension to rank among scientific men. Of course we exclude the "professional examiners," many of whom are men of high standing; but they are the servants, not the directors, of the company; they have but to work in their particular grooves, and that they can have no share whatever in its management must be clear to all from the fact that men of such abilities could never, if they had power to change it, suffer the continuance of a system subversive of the first principles of sound education, and most injurious to the public at large.

A series of examinations has been instituted for granting certificates to candidates, declaring them competent to teach particular branches of science. These examinations are held at South Kensington and in the larger cities of the empire, in twenty-two subjects, and candidates may take certificates in one or a dozen subjects. A candidate may fail utterly in eleven out of twelve, and yet receive a first-class certificate for the twelfth. For example, suppose he takes *Chemistry, Acoustics, Light and Heat,* and *Magnetism and Electricity;* he may be rejected in the last two subjects; and yet he may receive a first-class certificate in *Chemistry*, and be sent forth as a highly competent teacher of this science. We need not comment on this. Every one who knows anything about Chemistry is aware that it cannot be properly understood, much less taught, without a tolerably good knowledge of the principles of Light, Heat, and Electricity.

Here, then is a system professedly framed to meet present wants, to save us from sinking below our Continental neighbours, to make our artisans science-and-art workmen, to carry the benefit of scientific education amongst the working classes, founded on a principle diametrically opposed (if founded on any principle at all) to that which our universities and colleges are so strenuously labouring to establish and extend.

We have before had to notice the blunders of certificated teachers. Can we wonder at these when such tests of proficiency are required? And judging from the works of those who feel themselves called upon and competent to enlighten the public, and whose merits are recognised by the institution which sealed them with its sanction, and gave them places on its educational staff, what opinion are we to form of the great bulk of certificated teachers? Some may be competent, but the certificate is no proof of this, and we are left with the painful conviction that those who wish to learn are perhaps being taught by teachers of whose fitness for the work we have so poor an assurance. We call upon those interested in education and the welfare of the working classes to take steps to have this mischievous system checked or remedied without further delay. It is the more dangerous because it has Government support, and because its power to confer pecuniary benefits will always secure it interested defenders.

ORIGINAL COMMUNICATIONS.

LONDON WATER.

The Thames and New River Water in July. By J. A. WANKLYN, E. T. CHAPMAN, *and* M. H. SMITH.

DESCRIPTION OF WATER.	Date.	Free Ammonia.	Ammonia from Albuminoid Organic Matter.
West Middlesex Company.			
Supply pipe of house in Great Titchfield Street	July 3	·01	·066
Ditto, ditto	„ 16	·01	·064
Cabstand, Portland Road	„ „	·01	·064
Cabstand, Broad Way, Hammersmith	„ „	·01	·06
Grand Junction Company.			
Cabstand, Uxbridge Road, opposite Queen's Road	July 17	·01	·08
House in Shepherd's Bush	„ „	·01	·07
Cabstand in Piccadilly	„ „	Same.	Same.
Cabstand, Marble Arch	„ „	Same.	Same.
Chelsea Company.			
Cabstand, Palace Yard, Westminster	July 19	·01	·07
Stand-pipe near Victoria Station	„ „	·01	·10
Southwark and Vauxhall Company.			
Cabstand, London Bridge	June 21	·04	·204
Ditto, ditto	July 6	·03	·16
Ditto, ditto	„ 18	·015	·12
Stand-pipe opposite "Southampton Arms," Nine Elms Station	„ 18	·01	·15
Lambeth Company.			
Palace Road, Westminster Bridge	July 19	·015	·14
Cabstand Borough, Road	„ 20	·015	·15
New River Company.			
Supply pipe in house, Kingsland Road	July 20	·015	·05
London Institution	„ 12	·01	·05

The above table contains the results of the application to the waters supplied by the Thames Companies, and by the New River Company, of our direct method of estimating the nitrogen of the nitrogenous organic matters contained in waters. From the table it appears that the water supplied by the different companies differs much in quality. These differences must be due either to defective filtration or to some infiltration into the pipes of impure water. This latter view of the case derives some support from the fact that the different samples collected on the same day, in different parts of the same company's district, have different values. On the other hand, no marked increase of free ammonia accompanies the increase of ammonia from nitrogenous organic matter, as we should expect if the true cause were leakage into the pipes.

The West Middlesex Company appears to supply its district with water as good as Thames water, taken at the company's source of supply, can be made by filtration, and to supply all parts of its district examined by us with water of the same quality.

The Grand Junction Company's water appears to be as good, or almost as good, as the West Middlesex Company's, and here again no difference of importance could be detected between samples of water taken at different parts of the district. We are in the habit of applying the Clark process to this water on a sufficiently large scale to supply a household of five persons with water for drinking and washing purposes. The chalk removed is of a brown colour, and the colour of the water, as seen in mass, is improved.

The Chelsea water was found, at one portion of the district, to be of the same quality as those above mentioned, but at another portion of the district it yielded 40 per cent. more ammonia from organic matter. This may, we think, be set down with a strong degree of probability to infiltration into the pipes.

The Southwark and Vauxhall Company's water has been examined at various dates. At the earliest date some of the other London waters were found to be a little worse than at the date of the last examination; still, they never yielded half the amount of ammonia from organic matter that the water of this company did on the 21st of June. This result was not an isolated one, for water from the same source, on the 19th of the same month, yielded almost the same numbers. We conclude either that the water of this company is not so well filtered as that of the other companies mentioned above, or that a constant infiltration into its pipes must take place.

The Lambeth Company's water is in much the same state as that of the Southwark and Vauxhall Company.

The water of the New River has been examined many times and from different parts of the district, but has not recently differed appreciably from the two examples here given. It appears to be in as good a state as water taken from such a source can be rendered by mere filtration.

The above results have been obtained in summer, when the Thames water is said to be at its best. In winter we should expect that very different results will be obtained.

London Institution.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

PARIS; *July* 28.

Academy of Sciences—History of the Ecole Normale.

THE 'Comptes rendus' of the Academy of Sciences are at present full of interest; mineral, organic, and analytical chemistry being equally represented in them. There is an interesting paper by M. G. Lechartier, *On the artificial formation of Mimetesite, and of certain Chlorarseniates*; a communication of M. Bizio, *On the nature of the Glycogenic substance found in the livers of Vertebrated animals, and in the several tissues of Invertebrated animals*; and, lastly, a communication from Dr. Phipson, *On an easy method of recognising Bromine and Iodine in a solution containing both bromides and iodides.*

M. Lechartier observes, in the first place, that MM. H. Ste.-Claire Deville and Caron, in their memoir on Apatite and Wagnerite, have succeeded in producing artificially, not only these two minerals, but likewise a considerable number of minerals of similar constitution, which they have referred to apatite and wagnerite as types. Thus, apatite being represented by the formula $[(PO)'''_3Ca''_3O6]_3Ca''Cl_2$, and wagnerite by the formula $(PO)'''_2Mg''_3O6.Mg''F_2$, these chemists have succeeded in replacing the calcium by lead, strontium, or barium; the magnesium by calcium, manganese, or iron; the chlorine by fluorine; the fluorine by chlorine; and have thus obtained a series of minerals belonging to one or the other of the preceding types. Such are the plumbic, strontic and baric apatites, and the chlorocalcic, chloromagnesic, and chloro-ferroso-manganous wagnerites.

All the apatites crystallise in regular hexagonal prisms, and all the wagnerites in right prisms with rhombic base.

M. Lechartier, perceiving that the crystalline form of the mineral was not affected either by the nature of the metal or by the substitution of fluorine for chlorine, was led to suppose that chlorarseniates analogous to apatite and wagnerite might be produced by substituting arsenic acid for phosphoric acid in the artificial preparation of these minerals. This opinion was further supported by the analogy existing between the native phosphates and arseniates

with regard to their composition and crystalline form, and by the existence of mimetesite, a chlorarseniate of lead isomorphous with pyromorphite, to the type of which it belongs. Finally, that which afforded the strongest presumption in favour of M. Lechartier's idea, was that M. Debray, in 1865, had obtained an arseniated apatite either by heating arseniate of calcium $(AsO)'''_2Ca''_2H_2O_6$, in a sealed tube to 250° with a solution of chloride of calcium, or by fusing arseniate of calcium with an excess of the chloride.

M. Lechartier's expectations have been fully realised. To obtain arseniated apatites and wagnerites, he has recourse to the process previously employed by MM. Deville and Caron for preparing the phosphorated apatites and wagnerites. This process consists in dissolving the metallic phosphate or arseniate at a red heat in the chloride of the metal which forms the base of the salt operated on. The fused mass appears homogeneous, but the desired mineral crystallises from it on cooling. To introduce fluorine into the substance to be prepared, it is sufficient to mix the chloride which serves as flux with a fluoride of the same metal.

By proceeding in this manner M. Lechartier has prepared two arseniated calcic apatites, one containing chlorine, and the other fluorine; an arseniated plumbic apatite (mimetesite); and arseniated strontic and baric apatites. He has likewise obtained arseniated calcic, magnesic, and manganous wagnerites. The formulæ of these compounds are as follows:

Arseniated Apatites.

Arseniated Calcic Apatites......... $\left\{\begin{array}{l}[(AsO)'''_2Ca''_3O_6]_3.Ca''\left\{\begin{array}{l}Cl\\Cl\end{array}\right.\\ [(AsO)'''_2Ca''_3O_6]_3.Ca''\left\{\begin{array}{l}F\\F\end{array}\right.\end{array}\right.$

Arseniated Plumbic Apatite (Mimetesite)... $\left\{[(AsO)'''_2Pb''_3O_6]_3.Pb''\left\{\begin{array}{l}Cl\\Cl\end{array}\right.\right.$

Arseniated Strontic Apatite .... $\left\{[(AsO)'''_2Sr''_3O_6]_3.Sr''\left\{\begin{array}{l}Cl\\Cl\end{array}\right.\right.$

Arseniated Baric Apatite, $[(AsO)'''_2Ba''_3O_6]_3.Ba''\left\{\begin{array}{l}Cl\\Cl\end{array}\right.$

Arseniated Wagnerites.

Arseniated Calcic Wagnerite, $(AsO)'''_2Ca''_3O_6.Ca\left\{\begin{array}{l}Cl\\Cl\end{array}\right.$

Arseniated Magnesic Wagnerites......... $\left\{\begin{array}{l}(AsO)'''_2Mg''_3O_6.Mg''\left\{\begin{array}{l}Cl\\Cl\end{array}\right.\\ (AsO)'''_2Mg''_3O_6.Mg\left\{\begin{array}{l}F\\F\end{array}\right.\end{array}\right.$

Arseniated Manganous Wagnerite .... $\left\{(AsO)'''_2Mn''_3O_6.Mn\left\{\begin{array}{l}Cl\\Cl\end{array}\right.\right.$

In studying these several compounds M. Lechartier has verified a law previously established by Deville, namely, that the apatites contain as bases those metals whose carbonates crystallise in the rhombic form, like arragonite; but that the wagnerites, on the contrary, contain metals whose carbonates are rhombohedral, like Iceland spar. Calcium, whose carbonate crystallises in either form, is likewise capable of forming minerals belonging either to the apatite or to the wagnerite group. This fact is interesting, inasmuch as it shows that the difference observed between spathic and arragonitic metals is more essential than has hitherto been supposed. Apatites differ, indeed, from wagnerites, not only in crystalline form, but also in composition.

The several chlorarseniates obtained by M. Lechartier are soluble in nitric acid, a property which renders it easy to determine the chlorine contained in them by means of nitrate of silver.

The only difference observed by M. Lechartier between the production of the chlorarseniates and that of the chlorophosphates relates to apatite and wagnerite containing calcium. When phosphate and chloride of calcium are fused together, the product is always a mixture of apatite and wagnerite; but by fusing a mixture of arseniate and chloride of calcium, we may obtain at pleasure either an arseniated apatite or an arseniated wagnerite. At a high temperature the arseniated apatite is alone produced, whereas at a lower temperature, a little below the melting-point of chloride of calcium, nothing but wagnerite is formed. At intermediate temperatures these two bodies are produced simultaneously.

The memoir of M. Bizio is not less interesting than the preceding. A year and a half ago this Venetian chemist showed that several invertebrated animals contain a glycogenous substance in their livers; and by subsequent researches he has found that this substance is identical with that which is extracted from the livers of vertebrated animals; he has, moreover, subjected this substance to a thorough investigation, which I now propose to bring before you.

I shall pass rapidly over the physical properties of glycogen, which, according to M. Bizio, has a gummy consistence when dried slowly in the air after precipitation by alcohol, its ordinary pulverulent state being due merely to the rapidity with which it is usually dried.

The most interesting point of the memoir is the analysis of glycogen. This analysis, made upon the substance dried at 100°, or at ordinary temperatures in a vacuum, yielded, as might have been expected, numbers leading to the formula $C_6H_{10}O_5$.

But, on the other hand, the same glycogen, when dried in the air, agrees with the formula $C_{12}H_{22}O_{11}$, or, better, $C_{12}H_{20}O_{10} + aq$. This fact tends to show that the formula of glycogen should be double of the preceding. To verify it, M. Bizio precipitated a solution of glycogen with basic acetate of lead, and analysed the resulting plumbic precipitate, which yielded numbers agreeing with the formula $C_{12}H_{18}Pb''O_{10}$. Dry glycogen has, therefore, the formula $C_{12}H_{20}O_{10}$. According to this formula, it is the anhydride of a diglucosic alcohol, that is to say, of a body analogous to dextrin, and not to starch, which, according to the results obtained by M. Musculus, appears to be the anhydride of a triglucosic alcohol.

As the opinions entertained respecting the nature of starch and of bodies allied to it are still hypo-

thetical, although highly probable, everything relating to this question and capable of throwing a new light upon it presents especial interest. It is for this reason that we have called the attention of chemists to the recent communication of M. Bizio.

The memoir of Dr. Phipson is not so interesting as either of the two preceding. Dr. Phipson has shown that a solution of iodine in carbonic disulphide is completely decolorised by chlorine, the iodine being thereby converted into chloride of iodine, whereas a solution of bromine in the same liquid preserves its characteristic orange colour when subjected to the action of chlorine, that element not combining with the bromine under these circumstances.

Dr. Phipson has applied this reaction to qualitative analysis. He mixes the liquid containing the bromide and iodide with chlorhydric acid and carbonic disulphide, and agitates it after adding a small quantity of chloride of lime. The carbonic disulphide then assumes the violet coloration due to the presence of iodine. On continuing the addition of chloride of lime, if the substance to be analysed is free from bromine, the iodine passes to the state of chloride and the liquid becomes completely decolorised; but if the liquid contains bromine, the carbonic disulphide, though it still loses its violet tint, acquires instead of it an orange colour, which persists in spite of fresh additions of chloride of lime.

We will not express a decided opinion as to the value of this analytical process, as we have not yet tried it ourselves; but if, as the author asserts, it affords the means of recognising quantities of iodine and bromine too small to be detected by spectral analysis, its utility will be undeniable. Everybody knows, indeed, how difficult it is to detect bromine when mixed with iodine.

I would gladly speak to you, also, of a memoir by M. Lieben, which was published some months ago in an Italian journal, and has recently appeared in French in the 'Moniteur Scientifique' of Dr. Quesneville; but the extent and importance of this memoir induced me to defer it to another week, in the hope that the 'Comptes rendus' of the Academy may be less full of matter than to-day, and so leave space to speak of it. I shall conclude the present communication with a brief history of the École Normale, believing that the events which have recently occurred there will invest this history with a peculiar interest. Moreover, the École Normale is one of our most important schools, and as THE LABORATORY professes to give an account of the principal, educational establishments of foreign countries, I hope that a few words about the Ecole Normale may be acceptable to your readers.

The École Normale is a creation of the Revolution, having been founded by a decree of the Convention of 9 Brumaire, an. III (30 Oct., 1794). It was one of the numerous creations of public instruction, amongst which must be placed the Ecole Polytechnique, the Bureaux des Longitudes, the Muséum d'Histoire Naturelle, the Conservatoire des Arts et Métiers, the Musée du Louvre, the Conservatoire de Musique, and the Institut.

The École Normale was established, not only for the teaching of pure science, but also for instruction in the art of teaching. It was a school intended for the training of professors. The first teachers were men of renown—Monge, Lagrange, and Laplace, for mathematics; Berthelot, Thouin, Daubenton, and Hauy, for the physical sciences; Volney, Bernardin de St. Pierre, La Harpe, Garat, and Viard, for literature and philosophy.

The lectures of the first Normal School began in January and ended in May. They were published and widely circulated. They corresponded rather to the lectures of our Faculties than to those of our actual Normal Schools. They were not repeated. The 9th Thermidor had inaugurated the political reaction, and this, continually progressing, had sought to annihilate all the creations of the revolutionary era. The École Normale was consequently suppressed for about twelve years, and was not reconstituted till 1808. The new school, however, did not resemble that of the republican period. The Republic had established at the École Normale, as at the École Polytechnique, a true *externat*, a free course of instruction. For this the Empire substituted a rigorous *internat*, never giving leave of absence to the pupils. Another modification was the obligation imposed upon the pupils of assiduously attending the religious services; in a word, liberty was superseded by a system of minute regulations, and in this respect nothing was neglected. Even the uniform became the object of particular attention; according to the imperial regulation, the outfit must contain, amongst other things, two hats, one of which was French (or "chapeau à trois cornes"), twelve cravats, and two pairs of sheets.

With the suppression of liberty the character of the instruction had been lowered. There were no more special professors at the École Normale, but the pupils were obliged to attend the lectures of the Collège de France, the École Polytechnique, the Muséum, and the Faculté des Lettres. As to the school itself, it had no other special masters than a certain number of pupil-teachers (élèves répétiteurs), among whom, however, it was fortunate enough to number Villemain, Loubbroy, and Cousin, for literature, Dulong and Pouillet for the sciences. The conditions imposed by the decree on the pupils of the Normal School were not of a nature to render the instruction popular: hence, of the maximum of 300 pupils fixed by the decree, the school received only 45, and this number was never exceeded down to 1826, the date of its suppression.

In fairness, however, we must add that, if the system established by the imperial decree was not adapted to popularise the Normal School, it had at least one compensation which ought to be highly appreciated at the present day—the young men who entered there were exempted from military service, and enjoyed free maintenance.

The Restoration preserved the imperial system, merely relaxing it a little, so far as to allow the pupils to go out once a month, and improving it by establishing a special course of instruction, distinct from that of the Faculties. In 1826 the school was suppressed for political reasons. The minute supervi-

sion, and the pains which were taken to maintain the pupils in a spirit of attachment to the throne and the altar, did not prevent both pupils and professors from proving intractable, and it was for this reason that the government determined to shut up the school. Some time afterwards, under the ministry of M. de Martignac, it was partly re-established, but its complete reconstitution dates from 1830. After the revolution of July the course of instruction was enlarged; the gratuitous maintenance, at first limited to a small number of pupils, became the general rule; and eminent professors were appointed to direct the studies of the pupils. In 1848 nothing was changed in the Normal School except the costume; but the costume established by the Republic could not be tolerated by the Monarchy. In 1851, therefore, the ancient costume was re-established, and the puerility was carried even to the point of ordering the pupils to shave off their beards, under the pretext that, "puisque, grâce à l'énergie d'un gouvernement réparateur, le calme renait dans les esprits et l'ordre dans la société, il importe que les dernières traces de l'anarchie disparaissent." This sentence is taken word for word from the circular of M. Fortoul. Moreover, an annoying system of minute supervision took the place of the law of liberty which had previously prevailed. Happily this system did not endure, and matters have at length been restored nearly to the state in which they existed before the *coup d'état*.

It is only a few days since an event took place at the school. The pupils having congratulated M. Sainte-Beuve on the speech which he had made in the Senate in defence of the rights of free thought, the Normal School was closed. Fortunately, this disastrous event did not produce the bad effects which might have been expected. The school was reopened some days afterwards for half the pupils, and there is every reason to hope that the other half will be allowed to return after the vacation.

The École Normale, at the present day, possesses distinguished professors. Chemistry, which interests us more particularly, is represented there by M. H. Ste.-Claire Deville. This chemist has filled up a laboratory of mineral chemistry, in which many important discoveries have originated, and under his direction there has been formed a body of distinguished young chemists, namely, MM. Debray, Troost, etc. etc.

This slight notice of the École Normale being sufficient to give you an idea of the school, I will conclude this letter with the announcement that the nomination of M. Dumas to the post of Director of the Mint is an accomplished fact. N.

CORRESPONDENCE.

ELECTRIC ALARUM FOR AIR-BATH—DETERMINATION OF THE FUSING-POINTS OF ALLOYS.

To the Editor of THE LABORATORY.

SIR,—As a constant reader of your Journal, I trust the following short account of some recent experiments may, perhaps, be thought worthy a place in its columns.

My original intention was to make use of an alloy of known fusing-point, in conjunction with an electric-bell arrangement, to indicate a rise of temperature in an air-bath, a matter often of considerable importance. The form of apparatus was as follows:

A glass tube bent into the form of the letter U, having one limb much shorter than the other, is fixed in the bath by means of a perforated cork adapted to the longer limb, and to an aperture in the cover. Down the longer limb two insulated wires pass into the bend, so that their ends are beneath the mouth of the shorter limb. The ends of the wires are uncovered, but carefully kept apart by a very thin shaving of cork. A copper tube just small enough to pass into the mouth of the shorter limb has the fusible alloy cast into its centre. One of the insulated wires is connected with an electro-magnetic bell arrangement, and the other with a couple of Smee's cells.

The working of the apparatus will be readily understood. When the temperature of the bath reaches a certain point the alloy fuses, and immediately completes the connection of the previously insulated wires in the bend, and the bell rings. The apparatus is well adapted for a lecture experiment, but, owing to the convection currents in an air-bath, it needs some modification before it can be advantageously used in the laboratory for the purpose intended.

The above experiments subsequently led to its application in fixing the fusing-points of alloys. For this purpose the tube and alloy were similarly arranged, any small space between the copper and glass tubes being closed with plaster of Paris. The whole was thus immersed as far up as the alloy in a bath of mercury, having a thermometer in it, and to which heat was gradually applied. The temperature was noted upon the first stroke of the bell.

The fusing-points thus indicated were controlled by placing a similar copper tube containing the same alloy through a narrow cork into a wide glass tube, into which mercury was poured so as to surround the copper tube; heat was carefully applied, and the temperature noted at which the alloy fused out of the tube.

I will not take up your space with a detail of each experimental number, but may state that from a mean of many experiments by both methods there was only a difference of ·25 of a degree C. I propose to use this method for some future experiments.

I am, Sir, yours truly,

THOMAS BLOXAM, F.C.S.,
Lecturer on Science, Cheltenham College.

ARTICLES IN PREPARATION.—We have much pleasure in announcing to our readers that we have received from M. A. Naquet, of Paris, a paper which passes in review some remarkable statements made by M. Ste.-Claire Deville in two lectures delivered by him before the Chemical Society. We shall print this communication in our next. A very important article by Dr. Matthiessen and Mr. Hockin on the Determination of the Electrical Conducting Powers of Metals and Alloys, illustrated by several carefully-executed wood engravings, will appear immediately. We hope, further, to be able to give our readers a second article by Professor Kekulé in our next number.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,

AND E. J. MILLS, D.SC.

On Coriamyrtin and its Derivatives. *By* J. RIBAN.*

Coriaria myrtifolia, a very poisonous plant grow-in the south of France, in Spain, and in Italy, and formerly used in dyeing for the production of black colours, and sometimes for adulterating senna, owes its poisonous properties to a well-defined crystallisable substance called coriamyrtin, first obtained from it by the author in 1864.† This substance may be extracted from the berries or from the leaves of the plant; but the young shoots, from 40 to 60 centimetres high, gathered in March, yield the largest product, at least for plants growing in the latitude of Montpellier. The shoots are crushed in a mill and pressed; the expressed juice is treated with basic acetate of lead; and the filtered liquid is freed from excess of lead by sulphuretted hydrogen, then evaporated to a syrup, and repeatedly shaken up with ether, which dissolves the coriamyrtin, and leaves it on evaporation, in crystals having a slight brown colour. These crystals, after draining on a brick, may be rendered perfectly white and pure by one or two crystallisations from boiling alcohol. 1200 kilogrammes of young shoots yield about 87 grammes of pure coriamyrtin; but the yield decreases as the season advances, and towards the end of October it becomes very small.

Coriamyrtin is a white, bitter, very poisonous substance, crystallising in oblique rhomboïdal prisms of 98°40′, having the basal edges truncated. It is anhydrous, and melts at 220° to a colourless liquid, which solidifies to a crystalline mass on cooling, but turns brown if exposed to that temperature for some time. It is slightly soluble in water, easily soluble in boiling alcohol and ether. 100 pts. of water at 22° dissolve 1·44 pts. of coriamyrtin; 100 pts. of alcohol at the same temperature dissolve 2 parts.

The alcoholic solution turns the plane of polarisation to the right; for the transition tint $[\alpha] = 24 \cdot 5°$ at 20°.

Coriamyrtin is decomposed by fuming *iodhydric acid*, slowly in the cold, rapidly at 100°, a large quantity of iodine being separated, and a black soft substance deposited; and if the supernatant liquid be decanted, the black substance washed with cold water and dissolved in absolute alcohol, and the resulting solution mixed with a few drops of strong caustic *soda*, a fine purple red colour is produced, resembling that of an alcoholic solution of fuchsine.

This reaction is extremely delicate, being produced even with a milligramme of the substance. In operating with very small quantities, it is best to place the substance in a small capsule, moisten it with a few drops of fuming iodhydric acid, then heat it in the water-bath till the greater part of the acid is driven off; if now a small quantity of alcohol be added, and then a few drops of caustic soda, the characteristic colour will be produced.

Coriamyrtin is a neutral substance, neither saturating acids nor forming a precipitate with platinic chloride. It does not contain nitrogen, and is not acted upon by synaptase. It gives by analysis, 63·9 to 64·2 per cent. carbon and 6·6 hydrogen, agreeing nearly with the formula $C_{30}H_{36}O_{10}$, which requires 64·7 carbon, 6·5 hydrogen, and 29·8.

Bromocoriamyrtin, $C_{30}H_{34}Br_2O_{10}$, is formed on adding bromine, drop by drop, to coriamyrtin suspended in cold alcohol. It crystallises from boiling alcohol in fine anhydrous needles, slightly soluble in cold water, very soluble in boiling alcohol, and having an extremely bitter taste.

Chlorine, passed through a mixture of coriamyrtin and water, forms a crystalline substance composed of several amorphous chlorinated compounds, which cannot be separated by successive crystallisations.

Action of Bases on Coriamyrtin.—Most bases attack coriamyrtin in presence of water. With potash and soda only brown compounds are obtained; but with less active bases, such as baryta and lime, coriamyrtin assimilates the elements of five molecules of water, producing a dibasic acid, which unites with the base. Thus, when coriamyrtin is heated with water and excess of baryta to 100° for about two hours (best in an atmosphere of hydrogen), the excess of base removed by carbonic acid, and the filtered liquid evaporated, a brittle friable mass is obtained, which, when freed from adhering coriamyrtin by washing with ether, has the composition—

$$C_{30}H_{46}Ba''O_{16};$$

$$C_{30}H_{36}O_{10} + Ba''O + 5H_2O = C_{30}H_{46}Ba''O_{16}.$$

The calcium-salt, $C_{30}H_{46}Ca''O_{16}$, is obtained in a similar manner. These compounds are hygrometric, very soluble in water, slightly soluble in cold alcohol, insoluble in ether. They do not possess the bitter taste of coriamyrtin.

The acid, separated from them by sulphuric or oxalic acid, remains, on evaporation, as an amorphous mass. Its aqueous solution decomposes the carbonates of barium and calcium, with effervescence, reproducing the salts just described.

Coriamyrtin is likewise attacked by *litharge* in presence of water, yielding, after fifty hours' boiling, a soluble lead-salt resembling the barium- and calcium-salts in external character.

Action of Acids.—Coriamyrtin is dissolved and blackened by strong *sulphuric acid*. With *fuming nitric acid* it forms an amorphous nitro-compound, which detonates when heated. It is not attacked by dry *chlorhydric acid gas* even at 100°; but when heated to 200° with the aqueous acid containing 2 or 3 per cent. of that gas, it undergoes a complex change, yellow flocks being deposited after a while, and the liquid, which acquires the power of reducing potassio-cupric tartrate, retaining in solution two amorphous resinous bodies, which are soluble in water and in alcohol, one of them also in ether, but are very difficult to separate.

Acetic anhydride and coriamyrtin, heated together to 140° in a sealed tube for about an hour, unite directly, without elimination of water. The soft mass thus produced, if thrown into water to free it from

* 'Bull. Soc. Chim.' [2], vii, 79. † Ibid., i, 87.

acetic acid, ultimately falls to a powder, which may be washed with cold water, then dissolved in alcohol, separated by evaporation, and dried at 100° in a vacuum. It is transparent, nearly colourless, brittle, very bitter, melts below 100°, is insoluble in water, but soluble in alcohol. It has the composition $C_{42}H_{54}O_{19}$, which is that of hexacetic coriamyrtin combined with 3 at. water. Its formation is represented by the equation—

$$C_{30}H_{36}O_{10} + 3(C_2H_3O)_2O = C_{30}H_{30}(C_2H_3O)6O_{10}.3H_2O.$$

Glacial acetic acid forms a similar compound with coriamyrtin.

On certain Chromisulphocyanic Compounds. By J. Roesler.*

A tolerably concentrated aqueous solution of six parts of potassic sulphocyanide is mixed with a similar solution of five parts of chrome-alum, and the whole heated nearly to boiling for about two hours. The colour of the liquid is changed, in this manner, from violet to dark green; on cooling, it assumes a deep wine-red tint. Alcohol is added in order to precipitate the potassic sulphate, and the filtered solution yields quadratic crystals of potassic chromisulphocyanide on evaporation. The new salt is almost black in appearance, but is ruby-red by transmitted light. It is stable in the air, and does not alter when placed over sulphuric acid; water and alcohol both dissolve it, but it crystallises better from the latter. Potassic chromisulphocyanide has the formula†—

$$\left.\begin{matrix}Cy_{12}\\ CrK_6\end{matrix}\right\} S_{12} + 8H_2O;$$

and its formation is represented by the equation—

$$12KCyS + \left.\begin{matrix}(SO_2)_4\\ CrK_2\end{matrix}\right\} O_8 = \left.\begin{matrix}Cy_{12}\\ CrK_6\end{matrix}\right\} S_{12} + 4\left.\begin{matrix}SO_2\\ K_2\end{matrix}\right\} O_2$$

One part of the compound dissolves in 0·72 part of water. Alkaline carbonates and ammonic sulphide have no action upon it even in a boiling solution; but hot aqueous soda produces a precipitate of chromic oxide. When heated with dilute hydrochloric acid, in presence of ferric chloride, a blood-red coloration is produced; concentrated hydrochloric acid throws down potassic chloride and a yellow powder, which is, probably, persulphocyanic acid. Nitric acid easily oxidises the salt. Potassic chromisulphocyanide produces no precipitate in solutions of the metals of the barium group, nor with solutions of cadmium, cobalt, nickel, zinc, manganese, or iron. Cupric sulphate changes its wine-red colour into violet-blue, and, after some standing, yields a brown precipitate. Mercuric chloride gives a voluminous red, and mercurous salts a yellow precipitate; tin salts produce a white precipitate on long standing.

Ammonic chromisulphocyanide may be prepared either by dissolving freshly precipitated chromic hydrate in aqueous ammonic sulphocyanide, or by reducing one part of ammonic bichromate with alcohol and hydric sulphate in the usual manner, neutralising with ammonia, adding three parts of ammonic sulphocyanide, and proceeding further, as in the case of the potassium compound. To the last-named substance the ammonia derivative corresponds exactly both in formula and crystalline form.

The sodic salt is formed by dissolving in aqueous hydric sulphate the chromic hydrate precipitable from eight parts of chrome-alum, neutralising with sodic carbonate, and boiling with nine parts of sodic sulphocyanide. It is purified as in the two preceding cases. Sodic chromisulphocyanide is rather less stable, and rather lighter in colour, than the potassic or ammonic compound. It crystallises in thin leaflets, which are deliquescent in air, and fall to a light-red powder (with loss of water of crystallisation) when placed over oil of vitriol. The formula is—

$$Na_6CrCy_{12}S_{12} + 14H_2O.$$

In order to prepare the barium derivative the chromic hydrate from 5·5 parts of chrome-alum is dissolved in aqueous hydric chloride (the excess of which is afterwards driven off by evaporation), and boiled with the product of the action of five parts of ammonic sulphocyanide on 5·5 parts baric hydrate. Baric chloride is separated by crystallisation. Analyses of the chromic salt were in sufficient accordance with the expression—

$$Ba_3CrCy_{12}S_{12} + 16H_2O.$$

The body crystallises in short four-sided prisms of a deep ruby-red tint. It affords a convenient starting-point for the preparation of other derivatives.

Argentic chromisulphocyanide is a brown-red voluminous precipitate, formed by adding a solution of either of the corresponding salts already mentioned to one of argentic nitrate. The precipitate, when dried over oil of vitriol, still retains 53·91 per cent. of water; at 100° it is anhydrous, and has the formula—

$$Ag_6CrCy_{12}S_{12}.$$

Aqueous potassic cyanide dissolves it with a dark cherry-red coloration, but it is insoluble in ammonia.

If plumbic acetate be added to a solution in water of the potassium salt, a red precipitate—

$$Pb_3CrCy_{12}S_{12} + 4PbH_2O_2 + 8H_2O,$$

is thrown down; and this, on further standing or continuous washing with cold water, changes into the yellow body—

$$Pb_2CrCy_{10} + 4Pb_2H_2O_2 + 5H_2O.$$

At a temperature higher than 80° water produces the following decomposition:

$$Pb_2CrCy_{10}S_{10} + 4Pb_2H_2O_2 = 5PbCy_2S_2 + H_6CrO_6 + H_2PbO_2.$$

When hydric sulphide is passed through water in which the argentic or (red) plumbic salt is suspended, the solution filtered from the sulphide has a deep wine-red colour and a strongly acid reaction. On evaporation over oil of vitriol (or, in the ordinary way, with the aid of heat), hydric sulphocyanide and chromic sulphocyanide are produced. The solution cannot be used for preparing metallic derivatives, as caustic and carbonated alkalies both decompose it.

* 'Ann. Ch. Pharm.,' cxli, 185.

† Cr = 105.

Green or violet chromic salts may be employed in the preparation of the above sulphocyanic compounds.

On the Action of Potassic Cyanide on Dinitronaphthaline. By A. MÜLHÄUSER.*

Previous experiments of the author having convinced him that the green colour which is produced when the above-mentioned substances act on one another is due to the admixture of a blue and yellow product, he has set himself to examine more closely into the nature of the reaction.

The blue compound, which is the potassium salt of a new acid, is best prepared in the following way:—3 grammes of finely powdered dinitronaphthaline and 38 grammes of spirit are placed in a small flask, and, after well shaking, a solution of 6 grammes of "Liebig's cyanide of potassium" in 57 grammes of water is added. The mixture becomes red, even in the cold, and eventually red-brown. It is to be heated gradually to boiling, with frequent agitation. Much ammonia is evolved, and the solution, after assuming various transitory tints, eventually becomes of a beautiful blue-green colour. The flask is then to be removed from the source of heat, and the *solution* decanted into a beaker. After twelve hours' standing a dark potassium salt falls, having the lustre of copper; the mother-liquid is to be poured off and it is to be washed with cold water until the washings exhibit a pure blue tint. The substance may be further purified by dissolving in hot water, filtering through a wet filter, and adding potassic carbonate to the cooled filtrate; these operations are performed twice. After washing with water and drying over oil of vitriol, the product is to be repeatedly extracted with ether, to remove dinitronaphthaline and tarry matter. When dried at 100° it is pure, and has the formula—

$$C_{28}H_{17}KN_8O_9 + H_2O.$$

Potassic naphtocyamate (such is the proposed name of the new body) is insoluble in ether, but little soluble in cold water, more soluble in hot water or alcohol. Its tinctorial power is very great. Heated in a test-tube, it suddenly explodes, with the production of an aromatic substance and a voluminous charcoal. Hot concentrated potash destroys it, forming ammonia.

The ammonium salt is prepared by adding a strong solution of sal-ammoniac to a solution of the potassium salt. It is crystalline, and dissolves both in water and alcohol. The barium salt is a blue precipitate, which is formed when the potassium salt and baric chloride act on each other in presence of water. It becomes copper-red on drying. Neither cold water nor ether dissolves it, and hot water only very slightly; but boiling spirit (even if dilute) takes it up in large quantity. The analytical results correspond to the formula—

$$(C_{28}H_{17}N_8O_9)_2Ba.$$

The calcium salt is soluble in water; the lead salt is insoluble in either hot or cold water, but soluble in hot alcohol. The potassium salt also gives precipitates with the ordinary cupric, argentic, and mercuric reagents. The dry silver salt is a brittle mass, having the lustre of bronze. In explodes, on heating, with great ease, and is insoluble in water as well as in hot alcohol. A silver determination corresponded approximately to the formula—

$$C_{28}H_{16}Ag_2N_8O_9.$$

The potassium salt is attacked by acids with extraordinary facility, a mere trace of one turning the colour to green. Excess of hydric sulphate precipitates a dark brown powder, which is the free acid; and this, on drying, is a black, brilliant mass, insoluble in ether, almost insoluble in water, and readily soluble in presence of alcohol. The solutions have a clear brown-yellow colour. Fousel-oil easily dissolves the acid, forming a red-brown solution. These solutions are very sensitive reagents for the stronger bases, very small quantities of the latter producing first a green and then a blue coloration. Naphtocyamic acid has, if dried at 100°, the formula—

$$C_{28}H_{18}N_8O_9,$$

and, according to the author, is generated as follows:

$$2\left\{C_{10}H_6(NO_2)_2\right\} + 12HCN + 9H_2O = C_{28}H_{18}N_8O_9 + 4CO_2 + 8NH.$$

Crude hydric and potassic naphtocyamate are suggested by the author as probably advantageous substitutes for the reddened and blue litmus now in use in laboratories.

* 'Ann. Ch. Pharm.,' cxli, 214.

VARIA.

Mr. Pulford, of Dowgate Hill, Cannon Street, has called our attention to a misprint in our list of the Paris Exhibition awards (LAB., July 6, page 253). A bronze medal was awarded to Mr. Pulford for his "magnetic paints," not for magenta paints.

The 'Athenæum' thinks that the machine in operation for piercing the Mont Cenis is likely to be superseded by a new machine contrived by M. Pichet, in which diamonds play the most important part. These, consisting of what are technically known as black diamonds, are set in a steel ring, which is made to rotate rapidly, being pressed at the same time against the rock to be perforated. The diamonds grind the stone, be it ever so hard, and soon reduce it to powder, which is carried off as soon as formed by a current of water. The result of the operation is to hollow a cylindrical ring in the rock, leaving a core, which can easily be detached by percussion. M. Pichet's apparatus is now working on the tunnel of Port Vendres, where it is piercing at the average rate of about 3½ feet per hour. It is stated that the diamonds suffer but very slightly from abrasion, and that, when no longer of use for tunnelling purposes, they can be employed in the form of powder for polishing precious stones.

Communications Received.—A. Naquet; A. Oppenheim; J. A. Wanklyn; H. Watts; E. T. Chapman; A. W. Gillman; E. J. Mills; A. Matthiessen; C. Hockin; F.C.S.; "Inqurer."

Es wird uns ein Vergnügen sein mit den löblichen Redactionen der deutschen und anderen continentalen Journale und Zeitschriften über Chemie und Physik, denen die ersten Nos. des "Laboratory" zu Händen kommen möchten, auszutauschen.

Nous serons heureux de faire l'échange avec Messieurs les Rédacteurs des Journaux scientifiques (Chimie et Physique) qui recevront les premiers numéros du "Laboratory."

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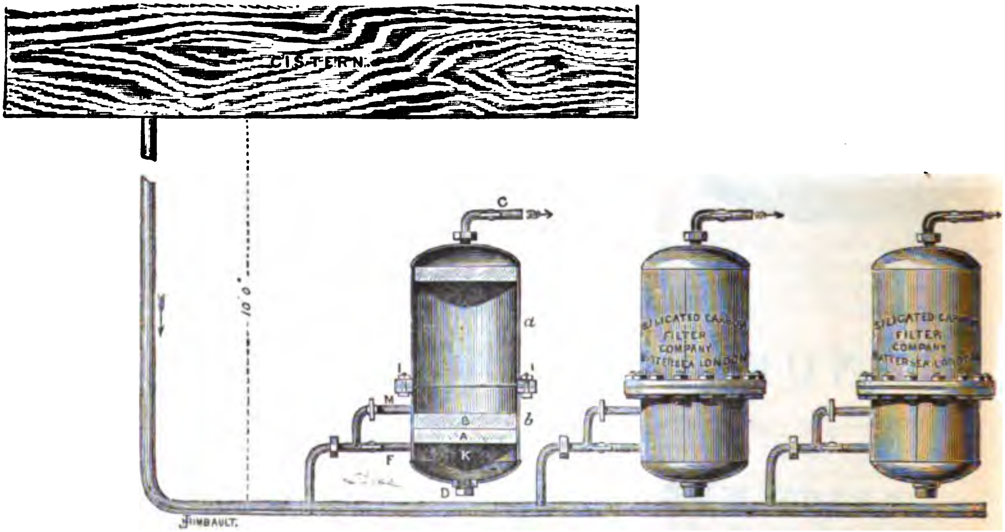

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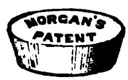

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THE LABORATORY:

A Weekly Record of Scientific Research.

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THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science.

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Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzosalicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *On Chlorophyll*, by Mr. Tichborne; *On a New Form of Sand Battery*, by Father Secchi; *On Brodie's Chemical Symbols*, by Mr. W. S. Jevons; *On a Method of Determining Vapour-Densities*, by Dr. Watts; *On London Waters*, by Messrs. Wanklyn, Chapman, and Smith; *Calculus of Chemical Operations*, by Sir B. C. Brodie; *On Affinity and Electricity*, by M. Georges Salet; *On the Destruction of Hyposulphites in Photographic Prints*, by Mr. Tichborne; *On Fruit Essences*, by Mr. H. N. Draper; *On "Violet de Paris,"* by M. Lauth; *On a New Form of Condenser*, by Mr. Barff; *Geber*, an Historical Study.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise Editorial Articles, Critical Reviews of Books, practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

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ORIGINAL COMMUNICATIONS.

M. NAQUET ON CHEMICAL AFFINITY.

Respecting Two Lectures of M. Deville on Affinity. *By* A. Naquet.

M. Deville, in two remarkable lectures delivered before the Chemical Society of Paris,* in February last, vigorously attacked the word *affinity*. He regards affinity as an occult cause, like friction, and would banish it from chemical science.

We have nothing to say in defence of occult causes. Opposed to all metaphysics, submitting all our theories to the control of experiment, we are compelled to coincide with what M. Deville has said respecting words introduced into science to mask our ignorance of real causes—words which can teach us nothing, but which arrest our investigations by making us believe that we really know what we desire to know. For all that, there are phenomena which may be advantageously expressed by a word. If we clearly define the words of which we make use, and if we properly limit the sense in which they are to be understood, the employment of these words cannot lead us into danger.

According to our view, this is the case with the word affinity. We see chemical phenomena taking place around us; we observe bodies entering into combination or being liberated from it, and we express the property which they possess of thus uniting one with another, by a word. We say these bodies have affinity one for the other.

M. Deville rejects this expression. He asks—What is this so-called affinity? What is it but a non-measurable force—a force which does not manifest itself by anything? If we expose to the sun a gramme of water, mixed with equal volumes of chlorine and hydrogen, we obtain hydrochloric acid, at the same time that 652 units of heat are evolved. If we return to the hydrochloric acid these 652 units of heat, the acid is decomposed, and we recover the separate elements chlorine and hydrogen, with their respective affinities.

To explain these facts it is not necessary to invent a particular force; there is only transformation of intra-molecular work into heat, and *vice versâ*. Affinity is a useless hypothesis, and should be rejected, for in science all that is needless is harmful.

In all this there is but one error, which is that M. Deville attributes to us opinions we have never entertained. He is evidently mistaken as to the sense which we attach to the word affinity.

What he himself says is perfectly true:—"If we desire to retain the word affinity, we must no longer consider it as the designation of the force which produces chemical phenomena. Let us accept it as a word representing the quality or property which bodies possess of combining or not combining under such and such circumstances, just as some bodies are coloured and some are not."

We have never said anything else. We have never pretended that there was a particular *fluid*, a force *sui generis*, upon which chemical phenomena depend. We have simply said that certain bodies have a tendency to combine, and it is to this property, to this special quality, that we have given the word affinity.

M. Deville does not limit himself to attacking affinity, he likewise makes an onslaught upon *cohesion*. To his thinking, solid bodies result from a species of felting. The crystalline molecules arrange themselves in certain directions, the mass contracts, and the body becomes more and more resistent. Such a transformation is in every case accompanied by an evolution of heat.

This explanation is admissible. But why do the crystalline molecules arrange themselves in a determinate manner? Why does the mass afterwards contract and evolve heat? In virtue of a special property inherent in these crystalline particles. Without that, all bodies would equally well assume the solid state and would become equally resisting, which is far from being true. It is this special property in virtue of which bodies are "felted" (to avail ourselves of the expression of M. Deville) that we call "cohesion."

M. Deville sets his face against this word. He is free to do as he pleases; but the discussion appears to us to be puerile. Discussion would be equally easy and equally profitless about any analogous word.

For example, we see bodies falling in a vertical direction when they are left to themselves. If a falling body be suddenly arrested in its descent, the pressure exercised on the obstacle can be expressed in kilogram-metres, and thence in units of heat, since we know the mechanical equivalent of heat. Are we to conclude from this that *weight* is an occult cause—that we ought to banish the word from science, and speak exclusively of the movement of heavy bodies and the measure of that movement? It is clear that we might avoid using the word, but in so doing we should gain nothing. We should, indeed, be doing harm, for the word weight—a simple word, which, when once defined, will not lend itself to an

* See Lab., April 27, p. 63.

equivocal meaning—would be replaced by periphrases always more obscure than a single word.

The discussion, we repeat, would be simply puerile if it were limited to what has preceded; but it is not so. M. Deville goes further. He denies combination, and treats it as a phenomenon of the same nature as solution and change of state. In denying combination one may say that he denies chemistry altogether.

The error committed by M. Deville is an error that is reproduced every day in every science, and is one which deserves our attention. When a fact is simple, the conditions which accompany it, and the phenomena which result from it, are themselves naturally few and little complicated. If afterwards we pass to a more complex fact of the same series, it may happen that we shall find a certain number of conditions identical with those appertaining to the more simple fact; it may even happen that among the phenomena arising from the complex fact we may come across some belonging equally to the simple fact. But these analogies do not constitute an identity. In resting on them to affirm the identity of the two orders of phenomena, we should be acting like a mathematician who persisted in neglecting certain terms of a series, under pretext that they might be neglected in the most simple cases, and that the terms which apply to the simpler cases are applicable also to the more complex.

M. Deville reasons just like this mathematician when he compares solution and change of state with combination. Change of state and combination doubtless display a certain obedience to similar laws, and manifest themselves by many analogous phenomena. But beyond these phenomena and these common laws, combinations obey special laws, and give rise to phenomena of which we find no trace whatever in change of state or in solution.

What is, in effect, the argument of M. Deville? The essential character which is given for distinguishing combinations of gases and liquids from simple solutions of gases in liquids, is that the union of the constituents is sufficiently intimate to resist changes of temperature and pressure, whilst in the case of a simple solution the gas is evolved by mere elevation of temperature or by a diminution of pressure.

Thus, as aqueous hydrochloric acid distils without alteration, this is held to be a combination; but as aqueous ammonia loses its gas when the temperature is raised, this is regarded as a solution. Now, according to M. Deville, there is in this nothing but the same single fact. Aqueous hydrochloric acid does not differ essentially from aqueous ammonia; they are both solutions, only one is more stable than the other, and demands for its decomposition a more elevated temperature.

In fact, he says, if we leave baryta in presence of bicarbonate of potash, a salt almost unalterable in air, we shall find that by degrees the baryta becomes carbonated, while the potassic bicarbonate is reduced to the condition of a neutral salt. In a similar way carbonate of lime decomposes in a vacuum at a temperature very much lower than that which effects its decomposition in air. Finally, bicarbonate of potash, exposed in a vacuum, gives off its carbonic acid as though it were heated. Thus, then, the acid carbonate of potash decomposes, at least partially, into carbonic acid and neutral carbonate under the influence of mechanical action. A simple solution of carbonic acid behaves in the same way under similar circumstances. M. Deville further insists on some facts of the same order, such as the decomposition at the ordinary temperature of the bicarbonates, of the sulphhydrates, of the sulphides, of the biacetates, and even, at a slightly elevated temperature, of the neutral nitrate of magnesia, under the influence of a prolonged current of nitrogen passed through the solution of these salts.

With M. Deville the explanation of these phenomena is very simple. The decomposition of bodies is only a change analogous to the volatilisation of liquids and of solids. A substance is vaporised at a temperature very much lower than that at which it enters into ebullition, and presents a vapour tension constant for a given temperature; in the same way substances begin to be *dissociated*, or partially decomposed, very much below the temperature at which they are entirely decomposed, and have a tension of dissociation constant for a given temperature.

The analogies pointed out by M. Deville are extremely interesting, and they are true. But where this chemist goes too far, is when he fails to see anything beyond these analogies.

It is quite evident, according to the mechanical theory of heat, that we ought to perceive a very great analogy between the decomposition on the one hand and the volatilisation of bodies on the other hand. In the one, as in the other case, a certain quantity of active force (*vis viva*) is absorbed in the form of heat and transformed into work. If it be a question of decomposition, the active force is employed in separating the material particles of the several elements which constitute the combination, whatever conception we may form of these particles. If, on the contrary, it is a question of change of state, heat still serves to separate the mate-

rial particles one from the other; but in this case the particles which are separated are of the same nature. It would be difficult to find two phenomena approaching more closely, presenting more points in common, and one might even say that the facts observed by M. Deville might have been foreseen *à priori*.

In changes of state there is a maximum tension of vapour, which corresponds to a given temperature, the tendency to volatilisation being compensated in part by the opposite tendency, and it is only when the tension of a vapour is in complete equilibrium with the external pressure that this second tendency is entirely overcome, and the substance enters into ebullition. It is, moreover, certain that if the vapours are not removed as fast as they are formed, the pressure will continually increase, and an extremely high temperature will be required for the complete vaporisation of a given quantity of liquid. In combination we have also two opposing influences, which are balanced, and must produce results analogous to those produced in the preceding case. Lime and carbonic acid, at a temperature sufficiently low, combine together entirely, the tension of dissociation of carbonate of lime being 0, or very nearly so. But accordingly as the temperature is raised, accordingly as heat is supplied to the salt, decomposition takes place; a kind of struggle is set up between the decomposing action of heat and the unknown property which had caused the carbonic acid and the lime to unite together. It follows that a portion of carbonate of lime is decomposed, and that if the decomposing action of heat is to the tendency of combination or affinity as A : B, the quantity of salt dissociated will be to the quantity of salt intact as A : B. The value A increasing with the temperature, a time will be reached when A = B, and at this moment decomposition is complete.

But the value A is not a function of the temperature alone; the density of the elements reacting on each other has also an influence. It is known that certain substances, such as spongy platinum and carbon, by condensing gases in their pores, and thus bringing them together with increased density, render possible reactions which would otherwise be impossible. It is not, then, a matter of indifference whether we operate under one pressure or under another, for the value A diminishes with pressure whilst it increases with temperature.

Moreover, how is it possible that pressure should not intervene? Its effect is to undo the work performed by heat, by bringing together the particles which heat has separated.

Up to this point, then, there is a perfect resemblance between the phenomena of combination or of decomposition and changes of state. But in the phenomena of combination there is something more, something which comes in as auxiliary to the preceding phenomena. This something, which M. Deville forgets, is combination in *definite proportions*.

Chlorine and mercury can unite together in two proportions, and their union as well as their separation is attended by certain phenomena analogous to those presented by the solution of gases and by changes of state; but the analogy between the two classes of phenomena is not complete. Gases may be dissolved in liquids in quantities increasing indefinitely with the pressure, at any rate, until the point is attained at which the gas liquifies. On the other hand, however great the pressure, it will never bring about the combination of more than 71 of chlorine with 200 of mercury; it will never give rise to tri- or tetra-carbonate of lime, which, if the ideas of M. Deville be exact, ought to be obtainable. In fact, one scarcely sees the reason why, according to these theories, carbonic acid should not combine with potash in quantity constantly increasing with the pressure, in the same way that it dissolves in water.

Further, if we take water charged with carbonic acid under the pressure of six atmospheres, and diminish the pressure borne by the liquid, a portion of the dissolved gas will be disengaged. After the disengagement the liquor will remain homogeneous; it will consist of water less charged with carbonic acid than before, but it will possess the same properties and the same composition in all its parts.

If, on the contrary, we take carbonate of potash and partially decompose it by elevation of temperature or by diminution of pressure, we do not get a homogeneous mass. We do not get a new carbonate intermediate between the neutral and the acid carbonate, but simply a mixture of acid and neutral carbonate in certain proportions. If the example chosen were such that one of the constituents was soluble, and the other insoluble, in a certain liquid, we might separate the one from the other with the greatest facility.

Here, then, we see what is the characteristic of chemistry. In chemistry, as in physics, all work absorbs a certain quantity of active force, which can be supplied to substances in the form of heat, and returned in that form when the work is undone. We have, therefore, in chemistry phenomena of the same order as those which are observed in physics; but we also recognise in it a property special and unknown, which compels substances to unite, and to unite in proportions always the same. This is the quality we call *affinity*. It is this that makes chemistry a science distinct from

physics, notwithstanding every effort that can be made to bring it within the domain of the latter.

M. Deville, in his war against affinity, profits also by a vexatious confusion which has been introduced into the science, and consists in taking the word affinity under a new acceptation and of confounding it with the word atomicity. "Moreover," says he, "without ever having defined this force and its measure (affinity), chemists speak of units of affinity. If affinity is a force, we may measure it in weight or by kilogrammes. They have not yet told us what is the value in kilogrammes of each unit of affinity."

M. Deville confounds things which are essentially different. The units of affinity which are spoken of have nothing to do with what is generally understood by affinity. M. Salet, in a remarkable article which will shortly appear in the new 'Dictionary of Chemistry,' edited by M. Wurtz, has condemned the use of this improper phrase. It is the unit of atomicity, and not the unit of affinity, of which we must speak. The tendency to combine shown by two substances may be strong or weak at a given temperature—that is to say, in order to be overcome, it requires a quantity of heat more or less considerable, and in every case easy to measure. This tendency to combine is *affinity*.

But an atom of a given body may combine with one, two, three, or four atoms of another body, whether its affinity for this latter be strong or feeble. This property is *atomicity*.

Oxygen has but little affinity for chlorine; but its atom can unite itself to two atoms of that metalloïd to form the substance Cl_2O. Oxygen is diatomic.

Hydrogen has a very great affinity for chlorine, and yet can only form with it the compound HCl. It is, therefore, monatomic.

When a substance is polyatomic, the fact is often expressed by saying that it possesses many centres of attraction or many units of atomicity, and sometimes, though improperly, many units of affinity. This atomicity will be satisfied when the polyatomic element shall have combined with the quantity of a monatomic element corresponding to its maximum atomicity, and in no other case.

As to atomicity, I propose to develop my ideas on this head in another communication, and to show that the atomic theories are not out of the domain of positive science. But whatever opinion may be held respecting atomicity, it is none the less true that the idea attaching to the word is absolutely different from that which attaches to the word affinity; and it would be taking a very unfair advantage to profit by a confusion of terms to attack one of these ideas by means of the other.

I have yet to say a word upon the ideas M. Deville has put forth in his lectures relative to isomorphism. He explains isomorphism by the use of infinitely small quantities and of supersaturated solutions. "Let us imagine," says he, "the carbonates of lime, of magnesia, of manganese, and of iron, under the conditions proper for their crystallisation, and at such a temperature and pressure that their elements shall have exactly the same forms; these conditions are realised in the mineral springs where these carbonates are formed and deposited every day. These solutions, like solutions of alum, are supersaturated alternately with each of these carbonates. These last are deposited in successive layers, thinner and more regular as their solubility is less and their relative proportions more constant. These complex crystals will be formed in parallel layers, indefinitely thin, in such a way that we may consider them as perfectly homogeneous, until a particular circumstance demonstrates that this homogeneity is merely apparent."

I shall not attempt to criticise this theory of isomorphism; crystallography is too far removed from my ordinary studies to allow me to criticise any theory whatever relating to it. I content myself on this point with indicating the views of M. Deville, but I doubt very much whether they will be accepted by mineralogists.

To sum up, and setting aside the deep interest which attaches to the facts M. Deville has mooted in his two lectures, facts which remain whatsoever be the interpretation we put upon them, we find that the lectures we have passed in review have been an unfortunate attack upon affinity, or rather upon chemistry. We say upon chemistry, for under the modest title of affinity it is chemistry that M. Deville from first to last has assailed, and which he has attempted to destroy as a distinct science in order to reduce it to a branch of physics.

Chemistry, however, exists. It exists as a perfectly distinct science, having its own peculiar methods and phenomena. There are physical phenomena in chemistry, just as there are chemical phenomena in biology; but we have no better warrant for merging chemistry in physics than we have for comprehending biology within chemistry—a result which M. Deville never could have dreamt of.

The above article supplements M. Salet's important communication *On Electricity and Affinity* printed in THE LABORATORY of July 6, p. 248, and the remarks of our French Correspondent (p. 63). In Chemical theory M. Deville meets a powerful antagonist in M. Naquet.

MR. BARFF ON STONE PRESERVATION.

On some Applications of Soluble Silicates. By F. S. BARFF, *M.A.* (*Cantab.*), *F.C.S. Part II. Preservation of Stone.*

AMONG the various applications of soluble silicates to the arts there is none that seems more worthy of attention than their employment as a means of protecting stone from decay. The subject is not a new one. Many processes have been tried with varied success; but it cannot be said that any one of them is perfectly satisfactory. At first it was supposed that a soluble silicate alone would bind together the particles of the softer kinds of stone, and in time, by atmospheric influences, form a protecting surface. This, however, proved to be a mistake, owing to the continued solubility of the silicate. Attempts were then made to obtain the protecting silicates by double decomposition, the theory being that the insoluble silicates so formed would fill up the pores of the stone and at the same time, by uniting with its particles, give them greater coherence. This method at first looked promising, as it at once imparted great hardness to the surface of the stone. On careful examination, however, this hardness was found to be due, not to the newly formed silicate, but to excess of the silicate of soda employed. The preservative action of this silicious surface was therefore no more lasting than that of a surface to which a single soluble silicate had been applied. In one instance *chloride of calcium* and *silicate of soda* were successively laid on in washes; silicate of lime was thus formed, but its particles were not coherent, and when the excess of silicate was washed out by rain or damp it was easily removed as a fine powder. Another objection to this method is the fact that silicate of lime is white, and requires colouring materials to be used with it (as, by precipitating a silicate, say of iron and lime), so that it may have a tint somewhat resembling the colour of the stone. But a more serious difficulty arose from the free alkali left in the stone forming salts, which crystallised and tended to break up the surface rather than to protect it. The first decomposition in this process sets free a quantity of chloride of sodium, which is anything but a desirable salt to have in a loosely combined stone.

Other indurating liquids have been tried, the most important of which is an *aqueous solution of silica* obtained by dialysis from a soluble silicate. To prepare such a solution, silicate of soda containing not more than 5 per cent. of silica, is placed in a dialyser with a slight excess of hydrochloric acid; the liquid should not be much over half an inch in depth; the dialyser floats in water, which should be changed from time to time, and tested with nitrate of silver till no precipitate of chloride is formed. The operation is completed in about forty-eight hours. The objections to the use of pure silica are—first, that unless the solution be kept very weak, it will gelatinise; and secondly, that when applied to the stone, which acts on it as a sort of dialyser, the water passes in, and the colloidal silica remains on the surface, from which it is easily removed. In fine, it seems that the union between the silica and the surface to which it is applied is simply a mechanical one.

A patent has been taken out for the employment of *hydrofluosilicic acid* as a preservative agent, but I know nothing of the results obtained with the process. It is, however, clear that the first action of the acid must be to decompose the parts with which it comes in contact, in such stones as dolomite, Caen, Portland, or Bath; but it has yet to be seen whether the silica forms a stable compound with the lime.

A process depending upon a reaction which sets free a destructive agent, as is the case with the chloride of calcium and a soluble silicate, or one in which a component of the indurating solution has to be got rid of, or neutralised by its action on the stone itself, as in the case of hydrofluosilicic acid, seems to be objectionable in theory, and has, at least, in one instance, been found to be so in practice.

It is generally said that inventors are sanguine; the truth of this assertion has been abundantly shown by inventors of processes for stone preservation. Utterly regardless of the nature of the material to be protected, whether stone, brick, or cement, the inventor declares that his particular process is capable of rendering all kinds of building materials hard and enduring, even harder and more imperishable than the best kinds of natural stone. Indeed, one inventor considers his process so perfect and comprehensive, that he has proposed to build war-ships of paper, and render them shot-proof by his invention! The extravagant pretensions of inventors and the failures consequent on their over-confidence have caused practical men to look with suspicion on all methods for making more lasting the softer and more workable kinds of building stones, the hardening and weatherproofing of which would bring within the reach of many carvings which might lay claim to artistic merit, and take the place of the incongruous Portland cement casts by which our modern domestic architecture is debased.

The question of stone preservation was made

the subject of a Parliamentary inquiry a few years ago, but nothing of any great value was elicited. The practical men examined regarded the matter entirely from their own point of view, which was anything but scientific; and the scientific men, as utterly regardless of practical considerations, made suggestions which could not be carried out. One distinguished chemist went so far as to recommend *silicic ether* as a likely material for coating the Houses of Parliament! However, notwithstanding the difficulties with which the subject is surrounded, there is enough of encouragement in what has been done to induce chemists to prosecute investigations further; and it is with a view to lay before them, and others not chemists who feel interested in the subject, the result of some years' experience that I have written this paper.

The process which I have already described as applicable to silicious painting* is similar to that which I believe will be found useful for stone preservation. I say useful, because I do not believe that any application at present discovered will in all cases succeed. The different constituents of the stone for whose preservation it is intended, and the different circumstances under which it is applied, must always have great influence on the result. A stone which is disintegrated on its surface, and to any depth below its surface, cannot be hardened by any silicious wash; a thin hard skin may be formed, but beneath it the loose particles will remain as they were and the skin will in time crack and peel off. The experiments which led to this conclusion were performed on some pieces of the old stone taken from Westminster Abbey, sent me by Mr. George Gilbert Scott, the architect intrusted with the restoration of that building. The stone is an oolite, and much decayed. The indurating process hardened it, but only superficially, and on the crust being broken the under parts remained soft as before. When the liquid was first applied the absorption was great, but it very soon ceased, as if the water had diffused in, leaving the silicate on the surface, and so preventing the absorption of after washes, which seemed only to thicken the crust.

Why more has not been done in this promising field of discovery is, I imagine, that too much has been attempted, and expectations raised which have not been realised. It is not possible to preserve a decaying stone without first scraping away all the decayed parts, and even when this has been done I have found great difficulty in indurating it in the laboratory, where one has every facility for working; and I believe it to be impossible to do it effectually when the stone stands perpendicularly in a building; for although the silicious solution, when thoroughly mixed with loose materials, will bind them firmly together, it will not do so when it can only percolate through them, and hence the failures which have attended all attempts to arrest decay in old stone, when it has gone on to any considerable extent, have caused disappointment, and too often have led to the abandonment of investigations, which might, if continued, have accomplished important results. At present our hopes in the preservative effects of silicious compounds must, I fear, be confined to the induration of new stone, or that which has shown only slight symptoms of disintegration. Every mason knows that when a stone is worked wet from the quarry the chances are much more in favour of its lasting than if it has been allowed to dry first. The quarry water contains silica in solution, as, I believe, an alkaline silicate; this, when the stone dries, determines to the surface, forming a hard, thin skin in combination with the superficial layer of the stone. Stone from the same quarry, often from the same bed, when worked under these different circumstances, gives very different results. In one place Bath stone lasts well, in another the same kind of stone begins soon to show signs of disintegration.

In the Houses of Parliament, where so much expensive work has gone to decay, and where the heads of kings endanger those of the passers-by, some stones are decayed, while others are as sound and perfect as when first placed in the building. Stone carvers prefer working dry stone rather than wet, and doubtless the drier and softer pieces were selected for the figures and ornaments, consequently no silicious film has been formed on the surface of the finished work, and, this protection being wanting, the disintegrating influences of the atmosphere have had their way unchecked, and the result has been that the carved parts have shown a much greater amount of decay than the wall stones.

Roche Abbey, a beautiful ruin near Sheffield, built of dolomite (the same stone as that employed in the Houses of Parliament), about the thirteenth century, shows no sign of disintegration and decay, other than what has been the result of violence. The quarry from which the stone was taken is close to the ruins, and from the conscientious care with which building work was done before the days of contracts, and when men felt an interest in the durability of their work, we may fairly argue that the present perfect condition of the stone is the result of the use of precautions which

* See LAB., pp. 20, 92.

every builder knows are necessary, in order to secure satisfactory and permanent work. The formation of the silicious crust, termed case-hardening, seems to preserve stone, which, when wanting this crust, rapidly decays. Old stone which has stood well for centuries, when re-dressed, soon begins to crumble away. We are therefore naturally brought to consider, whether, by imitating this case-hardening, and by making it thicker, and of compounds more enduring than those of which it is naturally composed (for its composition differs in different stones) we shall be able to effect the desired object. To get silica in a soluble state we are obliged to have present a large quantity of free alkali. This alkali may be considerably reduced by the addition of freshly precipitated hydrate of silica to a hot solution of an alkaline silicate until it will take up no more, and we get a compound approaching the composition $K_2O, 4SiO_2$, but we still have a quantity of alkali set free in the stone, and this is the difficulty which has to be overcome, because as long as the base is in excess the silicate is soluble, and, moreover, for reasons already stated, its presence is to be avoided.

The most reasonable plan is to use with the soluble silicate a reagent which will unite with both its constituents and form a new compound in which nothing will be left free, and which, from experience of natural products of similar constitution, will resist atmospheric and other destructive action. *Silicate of alumina* united with *silicate of potash* seems to effect this object. I need not here repeat my reasons for this opinion, as they have been fully stated in my previous articles on Silicious Painting. Experience has proved that when properly applied this mixture has prevented the decay of soft stone, such as Caen, in exposed situations; and one experiment to which I can refer clearly proves the truth of a statement already made, that it is almost impossible to arrest decay when it has once fairly set in, although it is perfectly possible to prevent the commencement of disintegration in stone which has been carefully indurated when in a good condition. I had a Caen stone building, part of which was decayed, coated with silicate of alumina and potash; the decayed parts were first scraped off down to the sound stone; in a year the decay recommenced, but the other stones remained perfect for several years, although all were from the same quarry and all worked under the same conditions and at the same time.

The results obtained from the use of silicate of alumina and potash have, on the whole, proved satisfactory; still, there are other substances which, combined with them, might render the product more lasting. Some natural varieties of silicate of magnesia lead one to think that this compound might be introduced with advantage, but the difficulty at present is how to get it into solution with silica. There is here a very wide field open to any chemist who will give attention to this subject.

For the information of those who are desirous of trying experiments, I will briefly state the method which I have generally adopted. Silicate of potash and aluminate of potash, made as already directed, and of the same specific gravities, should be mixed together and diluted. Here no general rule can be given as to the extent of dilution, as that must depend on the nature of the stone. With compact stones the solution must be used weak and the application repeated frequently, time being allowed between each coat for drying, and these applications should be continued till the surface has an egg-shell gloss; this gloss will in time disappear, and if the stone be examined with a strong magnifying glass the pores will be found to be filled with a white, almost opaque, glass-like substance. I have found it better in laboratory experiments not to dry the stone artificially, as the longer the time allowed the greater will be the penetration. When applied to a building, if the weather be hot and the sun powerful, it is better to keep the stone well soaked, but always discontinuing the applications when suction ceases, because, evaporation going on quickly at the surface, a skin is formed, which prevents further penetration of the silicate and the proper drying of that beneath. It may be necessary to repeat the operation some time after the induration is completed. In porous stones, the openings being large and the silicate drying gradually, the gelatinous mass first formed shrinks and leaves minute cracks, so that after a time it is better to repeat the washes once or twice to fill in these cracks. The colour of the stone so treated becomes at first rather darker, but in time the silicate becomes white; in no case is the stone-like appearance destroyed or injured. But the most promising application of this process, and that which will, I trust, in time become general, whether it, or any modification of it, be employed, is to fresh stone, especially to carved work, on which much labour has been expended. There is a process very generally used for kreosoting timber, in which the wood is placed in vessels from which the air has to a great extent been withdrawn. If stone, well dried, be so treated, and the indurating solution be admitted, it will penetrate to a very considerable depth, and so afford a most efficient protection against decay.

When damp penetrates any substance and frost ensues, the frozen water expands and destroys the coherence of the particles composing it. This is, perhaps, one of the principal causes of the perishability of porous stones, free access being thereby given to those destructive agents with which the air is charged. Such effects are prevented in stone indurated as I have suggested. No water can enter it, neither can the atmosphere injure it. If this method were adopted, original ornamental work could be employed where very objectionable substitutes now take its place; a bold and inexpensive and really artistic treatment, carried out in soft stone, could be used to decorate our street architecture, at present disfigured by meagre castings, arranged and repeated without meaning or design. By careful treatment even chalk can be made very hard and permanent in the open air, and capable of retaining the sharp edges given to it by the carver.

That the product formed by the proper admixture of silicate and aluminate of potash is really hard and enduring has been very fully proved. During the Exhibition of 1862 several samples of this product were exposed, some to dilute hydrochloric and some to dilute sulphuric acid; they are now perfectly sound, and so hard that they will scratch glass. Stone preserved with it has been submitted to very severe tests; and although many improvements can, I am sure, be made in the process, yet, on the whole, it seems the most likely to succeed, being founded on a sound principle.

EDITORIAL NOTES.

PROFESSIONAL IMMORALITIES.

Those who are fond of praising the good old times are not, perhaps, altogether wrong, either in point of philosophy or ethics; for there can be no doubt that, in many respects, we are worse, and not better off than our fathers. In no department of practice does our statement hold more true than in that of the professions. The evil, moreover, is not much mitigated by the fact that in each of them licences may or must be obtained previously to commencing active service. Take the case of medicine and surgery, for instance. A number of rival corporations offer their certificates to a candidate. Each certificate is not only "cheap," but "highly recommended;" even one of the very lowest class, from the greater length of title it confers, may be "good for mixing." Now, a man who is insuperably dull, or wilfully ignorant, or lazy, will naturally take advantage of the trade aspect which these examinations present; he will go where he can obtain a licence on the lowest pecuniary and intellectual terms. No wonder such backdoors are always open, and so many go in thereat! It is an easy process inside. Bland examiners cursorily inspect credentials and propose stock questions, a few delicate attentions are paid to a "subject," a fee is handed to the treasurer, and *Doctor* Saisrien—smiling, happy, and wondering at his former imperfect acquaintance with his own abilities—issues forth through the front door into the world. Let us not be understood to condemn those thorough, sound, and independent institutions which steadily refuse to allow a trade spirit to pollute their curriculum. But we are strongly averse to the existence of a commercial animus between educational corporations, and to the practical denial of one of the oldest lessons of life, that excellence is only to be obtained by long and assiduous toil.

The vices which preside over such a certificating system are naturally capable of speedy development. Doctor Saisrien sets up in business in a populous neighbourhood, and does his best to undersell the nearest practitioner. His stock-in-trade (alas!) consists chiefly of his brains; and, as we know, no great outlay has been necessary to license their exercise. Rapid and venturesome (or timid) surgery, with therapeutics to correspond, enable our novice to achieve something of popularity and a practice, until some shocking instance of maltreatment or ignorance on his part induces the Medical Council to check the future recurrence of such disasters.

Now, what is true for medicine and surgery holds good generally for professional chemistry. There are not yet, indeed, any licensing bodies recognised by chemists, if we except the University of London and, of course, South Kensington Museum (whatever that may mean). A man usually starts in life as a professional chemist, either with no training and no certificate at all, or else with a great deal of certificate and very little training. An exceptional few are well trained and properly qualified, with or without a certificate. The majority of analytical chemists are not more than six months or a year learning their profession, and many have to depend on what local celebrity they can gain for a maintenance. They have to fight for a living against men of reputation and eminence. Hence *Professor* Saisrien feels it necessary to rush into print on every possible occasion; to "perform" analyses of every kind for a few shillings; to deliver lectures on 'The Chemistry of a Four Pound Loaf;' and, ultimately, to give wonder-

ful evidence at inquests. Of course, as he calls himself a "chemist," the public take him at his word, supposing him to be a scientific man; and, as everybody knows, science gets all the discredit which may accrue when these people are employed. When waters are badly analysed at fifteen shillings, and coals at five, and arsenic is found, or not, "by desire," the public blame science. Moreover, it is notorious that some analysts uniformly get high results, others always reporting low numbers; of course, a seller or buyer knows how to take advantage of these facts. Sometimes, however, percentages can be trimmed low or high as required, which is, decidedly, a far more convenient and lucrative procedure.

It might be supposed that these are matters into which chemists ought immediately to inquire. By no means; chemists are already perfectly well acquainted with them. What is wanted is a remedy, and this, we believe, may be provided without delay. It would not take long for a corporate body like the Chemical Society to form a scheme of examination, of thorough and practical character, requiring the candidate to have previously devoted himself for two years' training, *at least*, at some recognised school. A certificate might then be granted in analytical chemistry. Prizes might further be offered for competition to any men who would bring up original work. Secondly, a scale of fees might be agreed on, upon which the licentiate should have a legal right to recover. Thirdly, the public should insist on an analyst possessing this certificate. Fourthly, the licensing body should have power to inquire into any cases of unprofessional conduct, and, if necessary, to suspend a licence.

The professional chemist is a creation of this century, and he is at present about fifty years old. His birth, parentage, education, and general mode of life, are perfectly well known to us. We are not, we must own, just now quite satisfied with him. Let us hope that some such steps as those we have suggested may be taken for his reform. In another ten years he may then become a purer, wiser, and, perhaps, repentant being.

CORRESPONDENCE.

ALBUMINOID MATTER IN WATER.

To the Editor of THE LABORATORY.

SIR,—Does Mr. Chapman's note in THE LABORATORY of July 27 (page 306) mean that "vital action" had converted the nitrogen compounds into organised albuminoids? If so, the observation is certainly interesting, but I should scarcely consider it to indicate an applicable means of purification. Yours, etc.,

F. C. S.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

Academy of Sciences—Lieben on Hydrocarbons and Pseudo-alcohols.—M. Wurtz.

PARIS; *August* 5.

THE 'Comptes rendus' of the Academy of Sciences are still full of interest for chemists. They contain a communication from M. Silva, which might become the point of departure of important industrial operations; also a note by M. Ed. Grimaux, *On the Benzylic Nitro-derivatives*, and a paper by MM. V. de Luynes and A. Lionet, *On the Methylic, Ethylic, and Amylic Derivatives of Orcin.*

M. Silva's communication relates to a titaniferous sand very abundant in the Cape de Verd Isles. It is exhibited by M. Borges, of Santiago (Cape de Verd Archipelago), and will be found in the annex of the Portuguese department. On examining this body M. Silva found it to be composed of a portion attracted by the magnet, and another portion on which the magnet had no action. The two substances were separated one from the other by means of a strongly magnetised bar, and analysed separately.

The portion attracted by the magnet contains—

Titanic acid	21·26
Iron (metal)	52·30
Magnesia	2·13
Alumina	2·20
Insoluble matter	1·20
Manganese	trace

This is the composition of titaniferous iron—

$$TiFeO_3.nFe_2O_3.$$

The non-magnetic portion of the sand contains titanic acid, silica, iron, lime, alumina, magnesia, manganese, and a residue insoluble in acids. These elements are probably contained in it in the form of rutile, silicate of lime and alumina, and emery. As, according to this constitution, the iron would be in the state of sesquioxide, and as part of the titanic acid is probably contained in the insoluble portion, M. Silva presents the results of his analysis in the following form:

Titanic acid	19·22
Silicic acid	31·20
Ferric oxide	18·84
Lime	10·50
Alumina	4·45
Magnesia	0·50
Emery	15·12
Manganese	traces
	99·83

M. Silva justly regards this ore as capable of furnishing material for a very important industry, on account of the iron and the titanium which it contains. It has long been known, indeed, that titaniferous irons are capable of producing steel of very superior quality. If, then, as appears probable, this

sand occurs abundantly in the Cape de Verd Isles, it might certainly be worked with advantage.

The note of M. Grimaux communicates the result of experiments still incomplete, which were given up by the author on hearing that M. Beilstein was occupied with the same subject. He had proposed to himself, in the first instance, to prepare two isomeric nitrated benzoic aldehydes, and two isomeric nitrated benzylic alcohols, corresponding to nitrobenzoic and nitrodracylic acids, both of which are represented by the formula $C_7H_5(NO_2)O_2$, and are produced by the action of fuming nitric acid upon toluene.

The first body prepared by M. Grimaux is the nitrated benzylic alcohol. It was obtained by Cannizzaro's process from Bertagnini's hydride of nitrobenzol. This body, when subjected to the action of alcoholic potash, is converted into potassic nitrobenzoate and nitrobenzylic alcohol, according to the equation—

$$\underbrace{2C_7H_5(NO_2)O}_{\text{Hydride of Nitrobenzoyl.}} + KHO = \underbrace{C_7H_4(NO_2)KO_2}_{\text{Nitrobenzoate of Potassium.}}$$
$$+ \underbrace{C_7H_7(NO_2)O.}_{\text{Nitrobenzylic Alcohol.}}$$

Nitrobenzylic alcohol is a viscid uncrystallisable oil, which decomposes on attempting to distil it under the ordinary atmospheric pressure, but boils between 178° and 180° C. under a pressure of three millimetres, assuming an amber colour. Pentachloride of phosphorus attacks it, forming a yellow oil, which cannot be volatilised without decomposition.

To obtain nitrodracylic alcohol (or, as he calls it, nitrodracethylic alcohol), M. Grimaux starts from a body which Beilstein had previously prepared by the action of fuming nitric acid on chloride of benzyl. This body, which corresponds to the formula $C_7H_6(NO_2)Cl$, or $C_6H_4(NO_2)CH_2Cl$, ought, in fact, to be regarded as the chloride of nitrodracethyl, inasmuch as it yields nitrodracylic acid by oxidation.

M. Grimaux gives some new details respecting the preparation and properties of the chloride of nitrodracethyl. It is a solid body, which crystallises in fine white needles or nacreous plates, very soluble in boiling alcohol and in ether, but insoluble in water. It melts at 70°, and may then remain liquid till cooled to 60°, but solidifies quickly at that temperature if agitated, becoming heated at the same time to 69°. It is easily prepared by gradually pouring chloride of benzyl into four or five times its weight of fuming nitric acid, kept cool to prevent the action from becoming too violent, and precipitating by water after some hours. The product separates in the form of a yellow oil, which after twenty-four hours solidifies to a buttery mass. It is purified by pressure between several folds of bibulous paper and repeated crystallisation from alcohol.

Chloride of nitrodracethyl, heated for some hours with an alcoholic solution of potassic acetate, yields chloride of potassium and acetate of nitrodracethyl, $C_6H_4(NO_2).CH_2.O.C_2H_3O$. This new body is slightly soluble in boiling water, more soluble in alcoholised water, very soluble in alcohol and ether. It crystallises in thin shining laminæ of white or yellowish colour, melting at 85°.

By treating acetate of benzyl with fuming nitric acid, with the view of obtaining an isomer of the body just described, M. Grimaux obtained a thick oil, which ultimately deposited a white solid body not yet studied.

To resume. We are now acquainted, thanks to the labours of M. Grimaux, with nitrobenzylic alcohol, corresponding to the already known nitrobenzoic acid and aldehyde, and with nitrodracethylic acetate, corresponding to nitrodracylic acid and nitrodracethylic chloride. As it is probable that the body formed by the action of fuming nitric acid on acetate of benzyl is the acetate of nitrobenzyl, and as, according to all appearances, the acetate of nitrodracethyl will be found to yield by saponification nitrodracethylic alcohol, we may regard the two isomeric series, of which nitrobenzoic and nitrodracylic acids are the pivots, as almost complete. There is, in fact, nothing wanting to complete them but the production of nitrodracylic aldehyde.

The communication of MM. V. de Luynes and A. Lionet is the most interesting of those which are contained in the 'Comptes rendus' of last week. It announces an unexpected fact. Orcin, $C_7H_8O_2$, has been justly regarded as a diatomic phenol. The action of acid chlorides on this body has already been shown to give rise to the formation of diacid ethers, which are saponified by bases like the compound ethers of the alcohols. It is, therefore, interesting to examine the methylic, ethylic, and amylic ethers of orcin, as everything tended to the supposition that in this case, as with the acid radicals, one or two atoms of hydrogen might be replaced. In order to verify this theoretical point MM. de Luynes and Lionet heated orcin with potash and methylic, ethylic, or amylic iodide, using for one molecule of orcin one or two molecules, and ultimately a large excess of iodhydric ether. Now, contrary to all expectation, this treatment has yielded, not only mono- and di-alcoholic, but also tri-alcoholic derivatives of orcin, namely, methyl-orcin $C_7H_7(CH_3)O_2$, ethyl-orcin $C_7H_7(C_2H_5)O_2$, amyl-orcin $C_7H_7(C_5H_{11})O_2$, diethyl-orcin $C_7H_6(C_2H_5)_2O_2$, diamyl-orcin $C_7H_6(C_5H_{11})_2O_2$, trimethyl-orcin $C_7H_5(CH_3)_3O_2$, triethyl-orcin $C_7H_5(C_2H_5)_3O_2$, and triamyl-orcin $C_7H_5(C_5H_{11})_3O_2$. In no case were products formed containing more than three molecules of alcohol-radicle in place of hydrogen. Not one of these several compounds is capable of being saponified and reproducing the phenol and the alcohol from which it is derived.

The first two classes of products may be regarded as alcoholic ethers of orcin, but such is not the case with the last. The radicals, which are united in ethers, are kept together by the intervention of oxygen. Now, as orcin contains only two atoms of oxygen, it cannot be more than diatomic, inasmuch as 2O can never bind more than two radicals to the fundamental group C_7H_6. We are, therefore, compelled to admit that in the trialcoholic products described by MM. de Luynes and Lionet, one alcohol-

radical, at least, must take the place of the non-typic hydrogen of orcin, and must, therefore, be directly attached to the carbon. The authors, have, therefore, effected a true synthesis. The formation of their compounds may be explained by a reaction of the iodhydric ether on the orcin. The potash, if it intervenes at all, acts only by combining with the iodhydric acid formed in the reaction, and thus preventing the secondary reactions to which this acid might otherwise give rise.

Beyond these three communications, the 'Comptes rendus' contain nothing particularly interesting, excepting a note of M. Blaserna, showing that induced currents, instead of being instantaneous, as is generally affirmed without any proof, have quite an appreciable duration. According to the physicist of Palermo, it might be possible in certain cases to demonstrate the existence of a feeble current, even $\frac{1}{300}$ of a second after the closing of the principal current. The induced current may be graphically represented by taking the times for abscissæ, and the corresponding intensities for ordinates. For times less than $\frac{1}{30000}$ of a second, the curve is closed by a straight line perpendicular to the axis of abscissæ; this curve bends and rises again, soon reaches a maximum, then descends rapidly, and after an inflection approaches indefinitely to the axis of abscissæ; but the point at which it reaches that axis cannot be exactly determined. In every case this point corresponds to a very appreciable time. I will not describe the apparatus used by M. Blaserna in his experiments, since his research, being purely physical, is rather foreign to the sphere of THE LABORATORY.

Leaving now the Academy of Sciences, I come to the research of M. Lieben, the existence of which I announced in the preceding letter; unfortunately, the little space which remains for this communication will not allow me to give you more than a short abstract of it.

M. Lieben's memoir is theoretical. He endeavours to determine the constitution of the hydrocarbons at present known in the series C_nH_{2n}, that is to say, of ethylene and its homologues, and thence deduces the true nature of the pseudo-alcohols of M. Wurtz, bodies which must be regarded as secondary alcohols, and of which no sufficient theory has hitherto been proposed, or at least demonstrated.

Ethylene, C_2H_4, is represented, according to M. Lieben, by the formula $\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$; it cannot, in fact, have more than two formulæ, namely, $\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$ and $\begin{pmatrix} CH_3 \\ | \\ CH \end{pmatrix}''$; the second, however, is regarded by M. Lieben as inadmissible, whereas the first is capable of accounting for all known facts. The reasons on which M. Lieben relies for rejecting the second formula are—(1) That the body $\begin{matrix} CH_3 \\ CH \end{matrix}$ or $C\left\{\begin{matrix} CH_3 \\ H \end{matrix}\right.$ would have a constitution similar to that of methylene, $C\left\{\begin{matrix} H \\ H \end{matrix}\right.$, and that, since the latter hydrocarbon does not exist in the free state, the existence of a body of the same constitution in which the hydrogen would be simply replaced by methyl does not appear very probable. (2) That the constitution of aldehyde now generally admitted being $\begin{matrix} CH_3 \\ | \\ C^{H}_{O} \end{matrix}$, chloride of ethylidene is necessarily represented by the formula $\begin{matrix} CH_3 \\ | \\ C^{H}_{Cl_2} \end{matrix}$, whence we may conclude that the formula $\begin{pmatrix} CH_3 \\ | \\ CH \end{pmatrix}''$ expresses the constitution of ethylidene, and not that of ethylene.

In addition to the arguments which attribute by exclusion the formula $\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$ to ethylene, M. Lieben further supports this formula by the following direct argument:

If the formula of ethylene is $\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$, that of bromide of ethylene becomes $\begin{matrix} CH_2Br \\ | \\ CH_2Br \end{matrix}$, and that of glycol $\begin{matrix} CH_2.OH \\ | \\ CH_2.OH \end{matrix}$; but if, on the contrary, the formula of ethylene were $\begin{matrix} CH \\ | \\ CH \end{matrix}$, that of glycol would become $\begin{matrix} CH_3 \\ | \\ C^{H}_{(OH)_2} \end{matrix}$

Now, according to the first formula, we may predict the existence of two acids derived from glycol, the one being $\begin{matrix} CO.OH \\ | \\ CH_2.OH \end{matrix}$, which is no other than glycollic acid, while the other $\begin{matrix} CO.OH \\ | \\ CO.OH \end{matrix}$ is oxalic acid. We may also predict the existence of two aldehydes, one of which $\begin{matrix} CH_2.OH \\ | \\ CH.O'' \end{matrix}$ has not yet been obtained, while the other $\begin{matrix} CH.O'' \\ | \\ CH.O'' \end{matrix}$ is the glyoxal of Debus. If, on the

contrary, we were to admit for glycol the formula $\begin{array}{l} CH_2 \\ | \\ C^{H}_{(OH)_2} \end{array}$, the first product of oxidation would necessarily correspond to the formula of acetic acid $\begin{array}{l} CH_3 \\ | \\ C^{O}_{OH} \end{array}$; and since acetic acid is not transformed into glycollic acid by direct oxidation, the production of glycollic acid by means of glycol would be incomprehensible.

With the formula $\begin{array}{c} CH_2 \\ \| \\ CH_2 \end{array}$ we easily explain that ethylene, by fixing HI, forms iodide of ethyl identical with that which is prepared from alcohol; there is no isomery possible. Everything in the molecule being symmetrical, it is clear that the product will remain the same whether the hydrogen be attached to one atom of carbon and the iodine to the other, or whether the opposite arrangement takes place; the result of the reaction is always $\begin{array}{l} CH_3 \\ | \\ CH_2I \end{array}$.

For the homologues of ethylene a large number of constitutional formulæ are possible. Among the formulæ given by M. Lieben in his memoir some are saturated, like that which we have admitted for ethylene, while others are analogous to that of ethylidene, and contain unsatisfied atomicities. The formulæ which represent the homologues of ethylene as forming closed chains are likewise numerous. Amongst them M. Lieben has been led to admit, as corresponding to the hydrocarbons actually known, the general formula $\begin{array}{l} C^{C_nH_{2n+1}}_{H} \\ \| \text{———} \\ C^{H}_{H} \end{array}$, representing all these bodies, as methylated, ethylated, amylated ethylene, etc. Thus, propylene would be $\begin{array}{l} C^{CH_3}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$, butylene $\begin{array}{l} C^{C_2H_5}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$, and amylene $\begin{array}{l} C^{C_3H_7}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$. To distinguish the hydrocarbons of this form from those of different constitution, which are pointed out by theory, M. Lieben proposes to call them hydrocarbons of the normal series.

The proofs on which M. Lieben relies for attributing to propylene the formula $\begin{array}{l} C^{CH_3}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$ are numerous; we shall, however, cite only the two following, which appear to us to be sufficient to establish the fact in question.

(1) Acetone corresponds to the formula $\begin{array}{c} CH_3 \\ | \\ CO \\ | \\ CH_3 \end{array}$, a constitution now universally admitted. Now, acetone when acted upon by pentachloride of phosphorus, exchanges its oxygen for two atoms of chlorine, yielding a chloride, $\begin{array}{c} CH_3 \\ | \\ CCl_2 \\ | \\ CH_3 \end{array}$, isomeric with chloride of propylene, and this chloride is converted, by loss of HCl, into a body which, according to Friedel, is identical with monochloropropylene, and necessarily corresponds to the formula $\begin{array}{c} CH_3 \\ | \\ CCl \\ \| \\ CH_2 \end{array}$. But if this body represents chlorinated propylene, the formula—

$\begin{array}{l} CH_3 \\ | \\ CH \\ \| \\ CH_2 \end{array}$, or $\begin{array}{l} C^{CH_3}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$, must represent propylene.

(2) The second proof is drawn from the constitution of iodide of allyl and the easy transformation of this body into propylene by the substitution of hydrogen for the iodine. We know that, according to Frankland, iodide of allyl is $\left\{ \begin{array}{ll} C & (CH_2)'' \\ & H \\ & \text{———} \\ & H_2 \\ C & I \end{array} \right. = \begin{array}{l} CH_2I \\ | \\ CH \\ \| \\ CH_2 \end{array}$. Now, by introducing hydrogen into this formula in place of the iodine, we have $\begin{array}{l} CH_3 \\ | \\ CH \\ \| \\ CH_2 \end{array} = \begin{array}{l} C^{CH_3}_{H} \\ \text{——} \\ C^{H}_{H} \end{array}$, which therefore represents the formula of propylene.

The reasons which M. Lieben adduces for assigning to butylene the formula $\begin{array}{l} C^{C_2H_5}_{H} \\ \| \text{——} \\ C^{H}_{H} \end{array}$ are much less conclusive than the preceding, and would certainly not suffice to establish his opinions were they not strengthened by analogy.

With regard to amylene, there certainly exists

a hydrocarbon $\left\| \begin{matrix} C^{C_3H_7}_{H} \\ \hline C^{H}_{H} \end{matrix}\right.$, namely, the synthetic amylene which Wurtz obtained by the action of allylic iodide on zinc-ethyl. This amylene is ethyl-allyl— $\begin{matrix} C_3H_5 \\ | \\ CH_2 \\ | \\ CH_3 \end{matrix}$. Now, by substituting for allyl, C_3H_5, the decomposed formula of this radical, $\begin{matrix} CH_2 \\ | \\ CH \\ | \\ CH_2 \end{matrix}$, we obtain for amylene the formula—

$$\begin{matrix} CH_3 \\ | \\ CH_2 \\ | \\ CH_2 \\ | \\ CH \\ | \\ CH_2 \end{matrix} = \left\| \begin{matrix} C^{C_3H_7}_{H} \\ \hline C^{H}_{H} \end{matrix}\right.$$

But by the side of this synthetic amylene of Wurtz there exists the ordinary amylene extracted from amylic alcohol. This last body, having been recognised as isomeric with the preceding, must evidently be represented by a formula different from that of synthetic amylene or normal amylene, if we adopt, with M. Lieben, the name of normal series for the hydrocarbons $\left\| \begin{matrix} C^{C_nH_{2n+1}}_{H} \\ \hline C^{H}_{H} \end{matrix}\right.$.

The constitution of ethylene and its homologues being once determined, M. Lieben thence deduces the constitution of the pseudo-alcohol. It is clear, in fact, that if this formula be established, each of the bodies which it includes may combine with hydracids in two different ways. On the one hand, we shall have—

$$\left\| \begin{matrix} C^{C_nH_{2n+1}}_{H} \\ \hline C^{H}_{H} \end{matrix}\right. + HI = \left| \begin{matrix} C\,{}^{C_nH_{2n+1}}_{\begin{smallmatrix} H \\ I \end{smallmatrix}} \\ \hline C\,H_3 \end{matrix}\right. ;$$

and on the other—

$$\left\| \begin{matrix} C^{C_nH_{2n+1}}_{H} \\ \hline C^{H}_{H} \end{matrix}\right. + HI = \left| \begin{matrix} C^{C_nH_{2n+1}}_{H_2} \\ \hline C\,H_2I \end{matrix}\right. .$$

If the reaction took place conformably with the first equation, the result would be a normal iodhydric ether; if, on the contrary, it takes place according to the second, the product will be the iodhydric ether of a secondary alcohol. Now, the actual product is the iodhydric ether, not of a normal, but of a pseudo-alcohol; hence we are led to conclude that the pseudo-alcohols are secondary alcohols, as was pointed out by Kolbe at the time of their discovery by Wurtz.

Wurtz, it is true, urges, as an objection to Lieben's theory, that the alcohol produced from artificial amylene is not identical with amylic pseudo-alcohol; but, as observed by Naquet, this objection, though serious, is not irrefutable. Amylic pseudo-alcohol, properly so called, and the alcohol produced from artificial amylene may both be secondary alcohols, and yet may differ from one another if they contain different radicals. Theory, indeed, points out to us a large number of secondary alcohols, all having the composition $C_5H_{12}O$; and it is by no means astonishing that these secondary alcohols should exhibit differences in their properties corresponding to the differences of their formulæ.

I will conclude this letter by informing you that the Minister of Public Instruction has transmitted to the Academy of Sciences a confirmation of the Imperial decree approving the nomination of M. Wurtz to the place in the chemical section vacant by the death of M. Pelouze. After the reading of the decree, M. Wurtz took his place amongst his colleagues. N.

PARIS UNIVERSAL EXHIBITION.

FRANCE.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

Bleaching processes—Decorticated seeds—Chemical apparatus—Platinum manufactures—Balance used in Electro-Plating—Aluminium and aluminium-bronze.

PARIS; *August* 6.

SCATTERED about the machinery department we shall find a large number of specimens of marble of surpassing beauty, mixed up with a heterogeneous collection of all kinds of machines and specimens relating to civil engineering. There are also several specimens of machines used in chemical processes, amongst which may be mentioned those shown by M. Tessier du Motay, illustrating his process for bleaching flax by permanganate of potash. He first roasts peroxide of manganese and caustic potash together, and lixiviates the compound. By this means he obtains a solution of manganate and permanganate of potash mixed with carbonate. Sulphate of magnesia is then added, which precipitates as the neutral carbonate. The impure solution thus obtained is reduced with water until the proportion of manganic salt reaches 3 per cent. The flax is dipped into it and allowed to remain for a quarter of an hour or longer, according to circumstances, the colouring matter being oxidised and bleached and peroxide of manganese precipitated in the fibre. It

is next alternately winced in a solution of sulphurous acid, which converts the peroxide into manganous sulphate, and in clear water, the operation of bleaching being completed in four or five hours.

Close by M. de Motay's machines are those of MM. Jarosson and Bastaert, for steeping and bleaching thread in the skein. For this purpose they dip the thread in a cold solution of caustic soda, containing from 2 to 4 per cent. of the alkali, after which it is steamed in a steam-tight vessel under pressure, the waste steam being used to heat the water employed in the after process of wincing. The employment of steam and pressure combined is stated, not merely to induce the more rapid destruction of the colouring matter of the thread, but also to improve its quality by rendering the subsequent bleaching process with chloride of lime more equal. Not only this; a weaker chloride-bath may be used, and the time necessary to complete the operation is considerably shortened. Thread prepared in this way is said to dye better than that bleached in the ordinary manner. The same principle is applicable to the bleaching of all kinds of cotton and linen fabrics.

In a case against the outer wall of the building M. J. Le Moine shows a series of decorticated cereals and seeds. He employs for this purpose a 3 per cent. solution of caustic soda, which loosens the outer husk, which, according to M. Le Moine, consists of nothing but ligneous fibre. This easily becomes detached by simple agitation, leaving behind the inner husk, containing a notable quantity of nitrogenous matter and alkaline phosphates. The decorticated seeds, singularly enough, do not lose their vitality during the process, being capable of germinating at any reasonable period afterwards. The refuse husks, which contain no nutritious or nitrogenous matter, may be used for paper-making. The operation is completed in from twenty to thirty minutes. In the case of barley a weak solution of sulphuric acid is substituted for the alkaline bath.

Close by M. Le Moine's case is the very small display of chemical apparatus by M. E. Rousseau, and some gas furnaces from Mr. Wiesnegg's manufactory. Neither of these makers show anything at all remarkable. Further on, on each side of the Rue de la Normandie, are three exhibitors of platinum apparatus, MM. Chapuis frères, Desmoutis and Quennessen, and Godart and Labordenave. In workmanship and size none of the apparatus shown at all comes near the noble display of Messrs. Johnson and Matthey, and none of them appear to have adopted the autogenous method of soldering applied with such success by their English competitors. With the exception of MM. Godart and Co., who in a few cases use a white solder, of which the composition is not given, they all employ the old method of gold soldering. MM. Desmoutis and Co. show a water-worn nugget of platinum weighing 6167 grammes, and MM. Godart some specimens of magnesium in ingot and wire.

Exactly opposite, on the innermost wall, are four or five displays of the white clay crucibles and furnaces for which the French were at one time so famous. At the corner of the Rue de la Normandie, going into the main building, we find the ingenious metallo-metric balance of M. A. Roseleur. It is employed to check the amount of silver deposited on any article during the process of electro-plating. It consists of an ordinary balance-beam, to one end of which is attached the article to be plated dipping into the bath; at the other end is a pan for containing the weights to be used, and half-way between this last and the fulcrum is a pin dipping into a little cup of mercury. While the pin is in the mercury the electric current is complete, but as soon as the piece of plate at the other end has received sufficient silver it falls into the bath, lifts the pin out of the mercury cup, and stops all the current, and consequently the deposit ceases. If, through any carelessness of the workman, the plated article remains sufficiently long in the argento-cyanide bath to lose any of its silver, it, of course, rises again and falls once more when the deposit is thick enough. This balance is almost universally used in Paris, where electroplate is covered with a determinate quantity of silver.

On the border ground between metallurgy proper and chemistry there are several displays which we feel bound to notice. The principal of these is the show of aluminium and aluminium-bronze, by M. Paul Morin. From the number of articles exhibited, this metal and its alloy appear to be in greater favour in France than in our own country. The dislike entertained in England to the use of aluminum as an artistic material no doubt arises from the fact of an enormous quantity of rubbishing brooches and other cheap jewellery having been introduced about the time of the Exhibition of 1862. The designs of these were so viciously bad that every one with the least artistic taste at once conceived a violent hatred to the new metal; but the display of works of art by M. Morin shows conclusively that aluminium may take its stand by the side of silver as an artistic metal. The statuettes, cups, and other articles shown are beautifully treated. In some cases the natural dead colour of the metal has not been interfered with; in others the scratch brush has been used to destroy its shining surface. A preparation of phosphoric acid is also used in some cases to "matt" the surface of the metal with excellent effect. Numerous bronze objects are also shown, containing from 5 to 10 per cent. of aluminium mixed with copper. It seems strange that, endowed as it is with the valuable properties of strength, toughness, and capability of being forged, both hot and cold, in so high a degree, that aluminium-bronze should not be more used in the construction of scientific apparatus than it is. M. Morin has two establishments, one at Nanterre, near Paris, where all the objects of art are manufactured; the other at Alais, where the metal is reduced from its ore. The ore used is bauxite, an indeterminate mixture of alumina and peroxide of iron, found in the neighbourhood of Baux, near Tarascon. The mineral is first pounded in an ordinary vertical grinding mill, and the powder obtained mixed with about half its weight of carbonate of soda. The mixture is strewn on the sole of a reverberatory furnace, and heated until all the carbonic acid is driven off, the alumina

uniting with the soda to form aluminate of soda, while the peroxide of iron is left untouched. The salt is thrown upon large filters and washed until nothing remains behind but the peroxide of iron. The alumina is next precipitated in the gelatinous hydrated form by a stream of carbonic acid ready for the formation of the double chloride of sodium and aluminium. The latter salt is made by mixing the hydrated alumina with suitable proportions of common salt and powdered charcoal into balls the size of a man's fist. When dry, these are thrown into retorts of suitable construction, heated, and submitted to the action of a current of chlorine. When the combination is effected the double chloride distils over, and is collected in earthern receivers, where it is allowed to cool and solidify. The formation of the salt is carried on both day and night, the furnace being replenished every ten or twelve hours. The double chloride, being mixed with certain proportions of cryolite and sodium, chopped up in small pieces, is thrown as rapidly as possible on to the floor of a reverberatory furnace, all the openings being immediately closed. At the end of a few minutes a series of explosions is heard, which announces that the reaction has begun; when the noise ceases, the whole is allowed to remain for an hour, when the door is opened, and the melted mass flows out. The metal is found in the form of globules enclosed in the slag, from which it is separated by pounding and washing, after which it is run into ingots and sent into commerce. It is calculated that, under the most favorable conditions, 30 kilogrammes of sodium, 200 kilogrammes of the double chloride, and 50 of cryolite, will produce 9 of aluminum, this figure being reduced to 8½ by the subsequent processes of melting and casting into ingots.

These alloys of aluminium-bronze are made at Alais, containing respectively 5, 7½, and 10 per cent. of aluminium. As tested by Mr. Anderson at Woolwich Arsenal, its breaking strain was found to be extremely high, as may be seen by the following table:

Aluminium-bronze at 10 p. c.	65	kilos the ☐	mm.
Krupp's best cast steel ...	53	"	"
Wrought iron	30	"	"
Gun metal....................	28	"	"

A hard-drawn wire is stated to have resisted a strain of no less than 90 kilogrammes on the square millimetre. It seems almost a pity that the word "bronze" should have been applied to this alloy, which presents so many points of dissimilarity with the mixture of tin and copper that we know in England under the former name. The misnomer has evidently arisen from the confusion that exists as to the meaning of the word "*bronze*" in French, which is as often applied to ordinary brass as to the alloy it really designates. Aluminium-brass, or cupraluminium, would be a better name, but it is, of course, too late. It is made by throwing aluminium into melted copper contained in crucibles. At first a reduction of temperature occurs, which partly solidifies the copper, but on stirring the metal with a bar of iron a violent action takes place, accompanied by the disengagement of sufficient heat to remelt the mass.

VARIA.

The Head Master of Clifton College, at the annual distribution of prizes, stated that, during the past session, increased attention had been given to the study of natural science. Two lecture-rooms and a large laboratory had been built, and two masters had been appointed in connection with the natural science department—Mr. J. B. Haslam, of St. John's College, Cambridge, and Mr. H. T. Roden, of the Royal School of Mines.

The premises of Messrs. Lamb and Sterry, paraffin wax refiners, at Rotherhithe, have been partly destroyed by fire.

Mr. George Grove, Hon. Sec. of the Palestine Exploration Fund, states that Mr. Prestwich, F.G.S., has offered his services to superintend the geological survey of the Holy Land. He asks for contributions to the fund.

According to the 'Pall Mall Gazette,' duelling, which has always been more or less prevalent among German students, has of late years become at certain universities almost a mania. At Bonn, especially, the number of duels which during the last few months have been attended with fatal results has been so great that the university authorities, who have hitherto winked at the practice, are, it is said, about to take steps for putting down duelling altogether. The students, too, are beginning to see the folly of this mode of settling their disputes, and both at Bonn and Berlin—another university noted for the pugnacity of its members—an agitation has been got up with the object of abolishing the academical courts of honour in which most of these duels originate.

Messrs. Gardiner, opticians, Glasgow, suffered to the extent of about two thousand pounds by the destructive fire which took place last week.

In the House of Commons, on the 1st instant, Mr. Bruce, in reply to Mr. Labouchere, said that the Provisional Committee of the Central Hall of Arts and Sciences was appointed at a meeting of the promoters, who intrusted them with full powers of management until the completion of the hall. The character of the charter was fully stated in the prospectus, and each subscriber received notice of the charter, and agreed in writing to accept it. No subscriber had objected to it, nor had any complaint on the subject been received by the provisional or the executive committee. The provisional committee, being numerous, appointed an executive committee, whose appointment was continued by the charter. The contract was entered into under the powers originally conferred on the provisional committee, and continued by the charter. The accounts were open to the inspection of any subscriber. The management had been conducted in all respects, including even the preparation of legal documents, without any charge to the undertaking. He was not aware that Government had any power to revise the charter. If its revision were really required by the majority of subscribers, the Board of Trade would probably make no difficulty about advising Her Majesty to assent to a wish so expressed to agree to a revision.

On the same evening, Mr. Gregory asked the Vice-President of the Council if Her Majesty's Government, in compliance with the recommendation of the Schools Inquiry Commission, had determined on instituting a special inquiry into the state and effects of technical education abroad.—Lord R. Montagu replied that the best suggestion seemed to be that which was contained in a letter of Mr. Robert Mallet, F.R.S. A roving commission would be "a holiday excursion at the public expense." The countries where systems of technical education were carried out were France, Prussia, Belgium, Switzerland, Bavaria, and Austria. All necessary information existed in those countries in a printed form. This might easily be procured by our diplomatic agents abroad and condensed in this country.—Mr. W. E. Forster trusted that the Secretaries of Legation would be requested, not only to send the information, but also to report on the subject.

In the House of Commons, on the 5th inst., Mr. Leader asked the Chief Secretary for Ireland whether Sir Robert Kane, the President of Queen's College, Cork, had accepted the office of permanent head of the College of Science in Dublin; and, if so, whether the Government would now carry out the following recommendations of the Royal Commissioners on the Queen's Colleges:—"We regard the non-residence of a President of a College as a serious bar to its well-being and progress. Such an officer is pre-eminently required in the Queen's Colleges. To the reasons relied on by Sir Robert Kane as supporting his view of non-continuous residence we cannot for a moment give our assent. We therefore consider that residence should be a condition of holding the office of President, and residence in the sense that the College shall be the President's home."—Lord Naas said the College of Science which had lately been established in Dublin was not in any way under the control of the Irish Government, and they had, therefore, no cognizance of what was going on there. But he thought the best answer he could give to the question of

his hon. friend would be to read the following letter he had received this morning from Sir R. Kaine:—"I have not as yet accepted the office of head of the New College of Science, nor has it yet been offered for my acceptance. I am now in charge provisionally of the Industrial Museum, doing the same duty as I have hitherto done, pending the completion of the new arrangements, as its director. I have been offered and have accepted the honorary office of Chairman of the Council of Professors, which involves no new duties, and to which a honorarium, not a salary, of £100 a year is attached. This is entirely a distinct matter from the headship or presidency of the new College. Your lordship is already fully aware of my entire willingness to be retired from Cork College if the office which I am proposed to fill in the new College of Science be rendered really that of administrative head and similar to that of President in the Queen's Colleges."

Communications Received.—W. H. Walenn; A. Naquet; C. W. Quin; H. Watts; A. F. Marreco; F. S. Barff; E. Frankland; E. J. Mills; M. Foster; R. C. C. Lippincott; G. Salet; J. Richardson; T. Taylor.

Editorial communications should be addressed to "The Editor," 4, Norman Terrace, Stockwell, S.; and all letters relating to business to the Publisher, James Firth, 42A, Cannon Street, E.C.

THE METROPOLITAN WATERS IN JULY.

Report on the Waters supplied to the Metropolis during the month of July, 1867, presented to the Registrar-General by* E. FRANKLAND, *F.R.S., Professor of Chemistry in the Government School of Mines.

1. COMPANIES.	2. Date and Place of Collection.	3. Total solid impurity in 100,000 parts.	4. Organic Carbon.	5. Nitrogen, as Nitrates and Nitrites.	6. Ammonia.	7. Total combined Nitrogen.	8. Previous Sewage Contamination. (Estimated.)	9. Total Hardness.
Thames.								
Chelsea	1st July, Cab Rank, Horse Guards	26·54	·212	·204	·006	·209	1105	19·7
West Middlesex	1st July, Cab Rank, Portland Road	26·20	·232	·182	·006	·187	885	19·4
Southwark & Vauxhall...	1st July, Barclay's Brewery	26·02	·237	·221	·008	·228	1295	19·7
Grand Junction	1st July, Cab Rank, Woodstock St.	24·86	·189	·319	·006	·324	2255	19·1
Lambeth......	1st July, Cab Rank, Westminster Rd.	26·24	·241	·276	·006	·281	1825	20·3
Other Sources.								
New River...	1st July, Cab Rk., Tottenham Ct. Rd.	24·22	·145	·199	·006	·204	1055	19·1
East London	2nd July, Waterworks, Old Ford	24·68	·206	·125	·006	·130	315	18·3
Kent	1st July, Waterworks, Deptford	38·52	·133	·374	·002	·376	2775	28·8
Loch Katrine	February 7th, Glasgow	3·28	·256	·031	·002	·041	0	0·3

For the purpose of comparison I append also the results yielded by Loch Katrine water, as supplied to Glasgow, when submitted to the same analytical processes.

The numbers in columns 3, 4, 5, 6, 7, 8, and 9, all relate to 100,000 parts of the waters. The Table is to be read thus:—100,000 lb. of Chelsea water collected on 1st July at the Horse Guards cab rank contained 26·54 lb. of solid impurity; the organic matter, constituting a portion of this impurity, contained ·212 lb. of carbon. This solid impurity also contained ·204 lb. of nitrogen in the form of nitrates and nitrites, besides ·006 lb. of ammonia, whilst the total amount of *combined* nitrogen in every form was ·209 lb. The above quantity of water supplied by the Chelsea Company had been, after its descent to the earth as rain, contaminated with sewage or manure matter equivalent to 1105 lb. of average filtered London sewage. By gradual oxidation, partly in the pores of the soil, partly in the Thames or its tributaries, and partly in the reservoirs, filters, and conduits of the Company, this sewage contamination had been entirely converted into comparatively innocuous inorganic compounds before its delivery to consumers. Finally, 100,000 lb. of the Chelsea Company's water contained 19·7 lb. of carbonate of lime, or an equivalent quantity of other soap-destroying ingredients.

The water of the Southwark Company was slightly turbid when drawn from the main.

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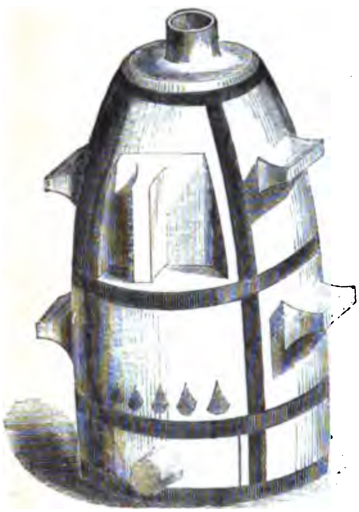

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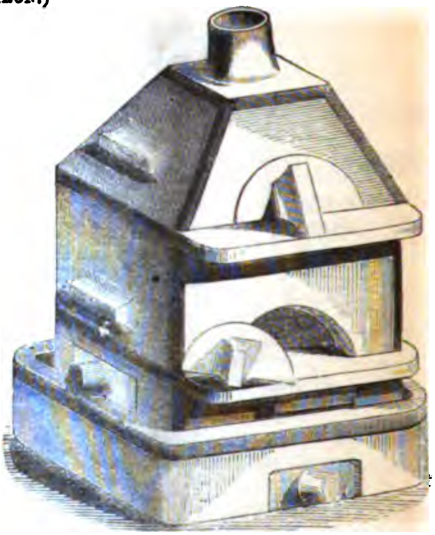

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THE LABORATORY:

A Weekly Record of Scientific Research.

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THE LABORATORY:

A Weekly Record of Scientific Research.

THIS Journal, commenced on the 6th of April, 1867, is addressed to cultivators and students of experimental science, and has already become an important medium of intercommunication for chemists, physicists, pharmaceutists, manufacturers, and scientific readers generally, in the United Kingdom and the principal intellectual centres of Europe and America. Original communications from men of high standing form the staple contents of THE LABORATORY, and the Editorial Articles, Reports of Lectures and Meetings, Reviews, Foreign Correspondence, Abstracts of Foreign Scientific Papers, and all other contributions which appear in its pages, are specially written for the Journal by a carefully selected staff, whose aim it is to impart accurate information in clear and precise language. THE LABORATORY is an independent organ of opinion, and has already attracted attention by its fearless remarks on abuses which affect the class to which it immediately appeals. THE LABORATORY is tastefully got up and printed on good paper, of a convenient size for preservation in bound volumes. Its articles are frequently illustrated by wood engravings of a high degree of excellence. In fine, no pains are spared to render the Journal worthy the support of all those who are interested in Experimental Science.

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Among the more important original contributions which have already appeared in this Journal may be cited—*On Alloys*, by Dr. A. Matthiessen and Mr. C. Hockin; *On Specific Gravity*, by the same; *On Isomerism*, by Dr. Mills; *On the Hydrides of Benzosalicyle and Disalicyle*, by Mr. Perkin; *On the Higher Homologues of Chinoline*, by Mr. Greville Williams; *On the Formation of Di-iodacetone*, by Dr. Maxwell Simpson; *On Silicious Painting*, by Mr. Barff; *On Limited Oxidation*, by Mr. E. T. Chapman; *On Chlorophyll*, by Mr. Tichborne; *On a New Form of Sand Battery*, by Father Secchi; *On Brodie's Chemical Symbols*, by Mr. W. S. Jevons; *On a Method of Determining Vapour-Densities*, by Dr. Watts; *On London Waters*, by Messrs. Wanklyn, Chapman, and Smith; *Calculus of Chemical Operations*, by Sir B. C. Brodie; *On Affinity and Electricity*, by M. Georges Salet; *On the Destruction of Hyposulphites in Photographic Prints*, by Mr. Tichborne; *On Fruit Essences*, by Mr. H. N. Draper; *On "Violet de Paris,"* by M. Lauth; *On a New Form of Condenser*, by Mr. Barff; *Geber*, an Historical Study.

Full reports of Dr. Frankland's Lectures on *Coal Gas* and on *The Water Supply of the Metropolis* have been given.

The regular features of the Journal comprise Editorial Articles, Critical Reviews of Books, practical Laboratory Notes, copious Abstracts of Foreign Scientific Papers; Correspondence from Paris, giving the proceedings of the Academy of Sciences and other learned bodies; Special Reports on the Paris Universal Exhibition; Original Reports of the Proceedings of the Chemical, Royal, and other Societies; and Announcements of forthcoming Meetings.

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ORIGINAL COMMUNICATIONS.*

PROF. WANKLYN ON MANCHESTER WATER.

On the Water supplied to Manchester. By J. ALFRED WANKLYN, *Professor of Chemistry at the London Institution.*

SAMPLES of the water supplied to Manchester were collected by me on August 19, and examined on August 21, with the following results. An analysis of a London water is appended for the sake of comparison.

Description of the Water.	Parts in 1,000,000. Free Ammonia.	Albuminoid Ammonia.
Manchester Water.		
Water taken from the tap in a house in Brazennose Street	0·01	0·07
From house in Cateaton Street	0·014	0·07
From Palatine Hotel	0·014	0·10
London Water.		
New River water, taken from a cab-rank near the London Institution, on Aug. 21, and examined same day	0·002	0·064

It would, therefore, seem that the Woodhead water, with which Manchester is supplied, is not any better, organically considered, than the New River water in the state in which the water company supplies it to London.

My colleagues, Messrs. Chapman and Smith, and myself, have already shown that Loch Katrine and Bala Lake furnish waters which (although very soft, like the Woodhead water) are, in point of putrescible matters contained in them, considerably worse than the average London supply in the state in which it actually reaches the consumers.

LABORATORY NOTES.

On Nitrite of Amyl. By ERNEST T. CHAPMAN.

HAVING had occasion to prepare large quantities of nitrite of amyl, my attention has been arrested by the great stability of this ether. Once obtained tolerably pure, it will bear distillation without undergoing any appreciable decomposition. It will even bear heating to 115° C. in a sealed tube for sixty hours without suffering more than a very slight degree of decomposition. The boiling-point is 97° to 98°, and is very constant.

Nitrite of amyl absorbs binoxide of nitrogen very readily, and when first prepared is more or less charged with this gas, which, however, may be removed by prolonged boiling. Probably these circumstances induced Mr. Tichborne to regard the ether in question as easily decomposable on boiling.

The method of preparation recommended by Mr. Tichborne, in the last number of THE LABORATORY, is calculated to give other products along with nitrite of amyl, and in my hands has yielded a very unsatisfactory product.

I find that the ordinary process, viz. the leading of nitrous acid (*got from arsenious acid and nitric acid*) into amylic alcohol, answers very well. The ether so obtained may be rectified without any particular loss.

London Institution.

* Our biographical sketch of Faraday has left little space for "Original Communications." We must, therefore, postpone the publication of the second paper "On the Determination of the Electrical Resistance," by Matthiessen and Hockin, until next week.

OUR FOREIGN CORRESPONDENCE.

FRANCE.

Concluding Sitting of the Academy of Medicine, Aug. 14—Meeting of the Academy of Sciences, Aug. 12.

OUR last week's correspondence having been interrupted, I must now give you an account of the proceedings of the week which has been passed over.

The important event of last week was the concluding sitting of the Academy of Medicine, held on the 14th of August. The amphitheatre was decorated for the occasion as for a grand ceremony. At the bottom was a semicircle, in which were seated the professors, the examiners, and the invited guests, while above and beyond the reserved semicircle were the seats occupied by the students. The floor of the interior was covered with a green carpet. The pupils entered by the ordinary doors, the professors, examiners, and guests, by the principal door, opening into the court under the arcade, which had been converted into a corridor by means of red hangings.

At the opening of the sitting, the Dean, M. Wurtz, called upon Professor Béhier for his panegyric on one of our most celebrated professors, M. Rostan, who died about a year and a half ago.

In recounting the life and works of M. Rostan, M. Béhier was obliged to enter into details of the controversies which M. Rostan had to sustain; that is to say, he was obliged, not only to speak of the ideas promulgated by M. Rostan himself, but likewise to give the history of the ideas and systems which prevailed in science at the same time. He traced with ability the history of the theories of Broussais and Laennec, in order to show the part played by M. Rostan in the controversies of those two great men.

We shall not follow M. Béhier into all his details, but shall content ourselves with noticing a passage of his discourse which appears to us to be wanting in logical consistency. This passage relates to the medical system of which M. Rostan was the creator, and to which he gave the name of *organicism*. This system, says M. Béhier, consists in not admitting in the organism any vital principle or force independent of the material organism. All physiological or pathological actions which take place in us are the result of the play of our organs, so that to every functional lesion there must necessarily correspond an organic lesion. To this theory two objections have been made, which M. Béhier recapitulates and replies to as follows.

It has been said, in the first place, that the system is hypothetical, in this respect—that in many diseases no organic lesion has been discovered by examination of the body after death. This argument had greater force at the time when the system in question was created by M. Rostan than at present, because since

then the number of diseases designated as *sine materia* has considerably decreased. The answer given to this objection by M. Rostan was the same as that now given by M. Béhier, and by almost all the physicians of the present day, namely, that our methods of anatomical investigation are limited, and that very often real lesions escape our notice, because they are too delicate to be appreciated by our existing means of observation. Since that time experience has tended to justify this system. A great number of lesions have been discovered which account for maladies previously regarded as *sine materia*. For example, we now know, through the labours of M. Marcet, that certain forms of mental alienation, in which it was formerly believed that no organic alteration could be discovered, and which were, therefore, regarded as diseases of the mind, are really due to an alteration of the nervous tubes.

The second objection urged against organicism is that this doctrine necessarily leads to materialism, and, consequently, to atheism. The proper way of dealing with this objection would have been to accept boldly the consequences which logically follow from the system, and to admit that, if there is no force independent of our organism, and capable of existing before that organism, or of surviving it, but if every function is simply the result of the play of an organ—or, as it has been recently expressed, of an apparatus—the existence of a spirit or soul independent of the body is impossible. Materialism is, indeed, the logical consequence of organicism. One must have the courage to declare one's opinions, and stand by them. This, however, has not been done either by M. Rostan or by his panegyrist, M. Béhier. "We are not philosophers," says M. Béhier, "and do not trouble ourselves with questions relating to metaphysics. For this we have not the requisite qualifications; our studies, our labours, do not tend in this direction. We are simply medical men, and shut ourselves up within the narrow domain of medicine. In this domain we assert that functions result from the play of the organs, and that there are no maladies without organic lesions; but at this point we stop, and do not concern ourselves with the mind and the soul." This seeming reply is really no reply at all; it plainly indicates a want of philosophic courage. M. Béhier does not, in fact, resolve the difficulty, but simply evades and declines to answer it.

What is the cause of this want of candour? It is that in France one must know how to stand well with all men; with the power which creates professors and defends religion, and with the students, who in certain cases can, by their opposition, turn out a professor, as last year—in fact, they turned out the former Dean, M. Tardieu. Now, students, or, at all events, the greater number of them, are materialists. The discourse of M. Béhier has a good word for each of the authorities whom it was necessary to flatter. He pleased the students by stating, without ambiguity, his belief in organicism, and he conciliated the ruling powers by repudiating materialism and atheism. The students were, perhaps, somewhat displeased with him for this part of his speech; but as he rather declined to answer the objection than replied to it negatively, they forgave him his want of candour in consideration of his affirmation of organicism, from which materialism flows so logically. You perceive that the discourse of M. Béhier confirms what I said in my last letter respecting the want of individual initiation, and the exaggerated respect for authority which shows itself in most of our men in office.

After the speech of M. Béhier, which was loudly applauded, the awards of the prizes were announced by M. Laugier, and the sitting was concluded.

This concluding sitting derived an especial interest from the circumstances of the time. From the commencement of the Faculty it has been the custom to hold an introductory sitting, to which all the world were admitted without distinction, the doors of the school being opened wide. But in these introductory sittings disorder and tumult had unfortunately arisen on several occasions, and to avoid the recurrence of such scenes it was resolved this year to replace the introductory by a concluding sitting. By this means the meeting was relieved of a large number of students who had already gone away. Moreover, instead of opening the doors of the school to everybody without distinction, they were kept shut, and no one was admitted into the amphitheatre but students provided with cards to establish their identity. A double purpose was thus answered; in the first place, the number of students present at the sitting was diminished, and those who were present were rendered more cautious in their behaviour; in fact, if they had made any disturbance their names might have been recognised by means of their cards. The plan has succeeded for this time; but it has offended the students, who, this year, at least, had resolved to be quiet. It is just possible that the consequence may be the very opposite of what was intended, as many of the students talk of making a disturbance at the lectures of the dean and the principal professors in the following session. I should be glad if this unusual excitement were to subside, and that the lectures might be resumed in November as usual; but I fear that this will not be the case, for past experience shows that administrative rigour is generally rather hurtful than beneficial. It must, however, be observed that the students will be unjust if they resent their grievances upon the dean. Indeed, the part which M. Wurtz has played in the affair has been simply to moderate the rigour which the Minister of Public Instruction wished to exert. M. Wurtz, in fact, insisted on the delivery of cards to all students who wished to be present, whereas the minister wished to admit only the boarders and those day-scholars to whom letters of invitation had been given, while the rest were to be absolutely excluded.

At the meeting of the Academy of Sciences on the 12th of August, there was no communication relating to chemistry, but there were two papers of historical interest. Some weeks ago M. Chasles published some letters which seemed to show that Newton, in his youth, had been in correspondence with Pascal; that in this correspondence he had obtained the germ of the ideas which directed his

labours, and that, consequently, part of the glory of the discovery of universal gravitation is due to Pascal.

Sir David Brewster, the biographer of Newton, has returned to this question. After having carefully examined all the papers and correspondence of Sir Isaac Newton, which are preserved at Hurstbourne Park, the residence of the Earl of Portsmouth, a member of his family, he asserts that no paper bearing the name of Pascal exists in this collection. Sir David Brewster likewise observes that, amongst the letters cited by M. Chasles, there is one from Newton's mother, Ann Ayscough, thanking Pascal for his kindness to her son, and one from Pascal to Boyle, bearing the date of 1654, in which Pascal speaks of having received from Newton a memoir treating of the Infinitesimal Calculus, the System of Vortices, the Equilibrium of Fluids, and Gravity. Now, if these letters were authentic they would be very curious. Newton's mother having married again, and taken the name of Hannah Smith, when her son was only four years old, she must either have signed her letter to Pascal with her own name, or have thanked Pascal for his kindness to her son when the latter was only four years old, which is inadmissible. As to the letter of Pascal to Boyle, it would be no less extraordinary, since in 1654, the date at which it is said to have been written, Newton, who was then only eleven years old, had certainly not written any memoir on Gravity, the Equilibrium of Fluids, the system of Vortices, or the Infinitesimal Calculus.

From all these considerations Sir David Brewster concludes that the letters formerly published are most probably apocryphal, and that the glory of the discovery of Universal Gravitation really belongs to Newton, and to him alone.

M. Chasles replied at the same meeting. Setting aside those documents of Pascal, the authenticity of which has been referred to the examination of a commission, he nevertheless maintains that a certain correspondence existed between Pascal and young Newton. His assertions are based upon four classes of documents, namely,—

1. Letters addressed by Miss Ann Ayscough, the mother of Newton, and by Aubrey to Pascal, and the letters of Hobbs to Mariotte and Clerselier.

2. Letters addressed by Newton to Mdme. Perrier, the Abbé Perrier, Rohault, Saint-Evremond, Desmaireaux, and Malbranche.

3. Letters addressed to Newton by Mdme. Perrier, Rohault, Clerselier, and Mariotte.

4. Letters from certain scientific and literary men of the beginning of the last century—Montesquieu, Desmaireaux, Rémond, Louis Racine.

All these letters seem to show that Newton, after having received from Pascal, and found in the writings of Descartes, the ideas to which his discoveries must, in great part, be attributed, purposely avoided speaking of these philosophers, probably with the view of appropriating to himself the entire glory of his discoveries.

It is difficult for the public to judge whether the documents cited are authentic or not; but however this may be, it appears to us that M. Duhamel has completely decided the question which they raised, in the few words with which he closed the discussion. After having protested against these letters, which exhibit Newton in an odious light—and this, too, without any proof of their authenticity—he asserts that nothing but ignorance of the labours both of Newton and of Pascal could give support to the assertions which they contain. The mathematical discoveries of Newton relate to the theory of equations, of series, and of infinitesimals under two different points of view. He is the creator of the theory of curvilinear motion, absolute and relative, and it was by applying this theory to the study of phenomena known from observation that he arrived at the law of universal gravitation. As no single labour of Pascal relates to these theories, it is impossible that Newton can have found the germ of them in the works, or even in the conversations, of Pascal. According to M. Duhamel, the true predecessors of Newton were, not Pascal, but Descartes and Fermat. But men of genius take up science from the point to which it has been carried by those who have gone before them, and it would be the height of injustice to reproach them for it.

To resume. It seems to us, little versed as we may be in the matter, that the question is exhausted; that, whether the letters are apocryphal or not, and whether Newton in his youth had or had not any correspondence with Pascal, it is quite certain that to him alone belongs the discovery of universal gravitation.

At the same meeting, the Academy of Sciences received a letter from MM. Wolf and Royet *On the Solar Spectroscope*. These observers have analysed the light of three stars belonging to the constellation Cygnus. They have observed that the spectra of these three stars constantly exhibit bright lines, as already observed for the spectrum of γ Cassiopœiæ. They have endeavoured to identify these bright lines with those of the incandescent gases with which we are acquainted. In this, however, they have not succeeded; and they infer that, according to all appearance, the three stars in question contain a substance in the gaseous state different from all substances known to us. If this discovery should be confirmed by further observation, it will be of the highest interest, as it will show that the unity of composition of our system does not extend beyond it, and that the stars in the different regions of the heavens are not formed of the same kind of matter. This last point once established, would give a certain weight to the hypothesis of Laplace, and would lead us to believe that stars which exhibit the same composition have in reality a common origin.

The meeting of the 18th of August was richer in chemical papers, but want of space compels me defer the analysis of them to our next correspondence.

N.

The British Pharmaceutical Conference still maintains its connection with the British Association in regard to its place of meeting. The proceedings will be opened by the President, Professor Bentley, on Tuesday next, at Dundee.

PARIS UNIVERSAL EXHIBITION.

BELGIUM AND PRUSSIA.

BY C. W. QUIN, F.C.S.,

Superintendent of the Chemical Classes of the International Exhibition of 1862.

Belgian minerals—Iron, zinc, lead, nickel, and cobalt ores—Nickel alloy—Chemicals—Phenol derivatives—Prussian minerals—Cubes illustrating the amount and value of the produce—Salt trophy—Model of Stassfurth mines—Collection of economic minerals shown by the Minister of Mines—Krupp's steel—Spiegeleisen—Iron, copper, zinc, silver, nickel, and indium.

PARIS; *August* 27.

THE finest show of iron in the Belgian Court is undoubtedly that of the John Cockerill Company, whose immense engine-building establishment at Seraing, near Liège, is one of the largest in the world. They also have ship-building yards at Antwerp and St. Petersburg, 2175 hectares of coal mines, 875 hectares of iron mines, in the provinces of Liège, Namur, and Luxembourg, and employ altogether nearly 8000 men. Their coal mines yield them annually 260,000 tons of coal, their iron mines 146,000 tons of hydrous oxide and red hematite, which they convert into 50,000 tons of pig iron, 26,000 tons of wrought iron, and 5000 tons of Bessemer steel. Amongst the iron ores shown may be mentioned the micaceous manganiferous ore exhibited by the Prince of Capua, which contains 29 per cent. of metallic iron and 23 per cent. of manganese. The prince also shows manganese ore containing a high percentage of peroxide. The Vieille Montagne Zinc Company, who likewise exhibit in France and Prussia, make a very fine display. This is another of those gigantic establishments which are so common on the Continent. They employ nearly 7000 workmen of various kinds at their mines and foundries in Belgium, Prussia, France, and Sweden. In Belgium they possess lead, calamine, and blende mines, coal mines, a zinc white factory, rolling mills, and smelting works. In different parts of Germany they have coal mines, copper, lead, calamine, and blende mines, rolling mills, and foundries; a zinc white works and rolling mills in France; and zinc, copper, and cobalt mines at Ammeberg, near Askersund, in Sweden. They turn out annually 32,000 tons of zinc, 23,000 of which is made in Belgium and the remainder in Prussia. They roll annually 25,000 tons of sheet zinc, and make 6000 of zinc white. They show some interesting specimens of zinc ores in the collective exhibition already mentioned. Their mines at the Vieille Montagne, near Moresnet, in the neutral territory between Belgium and Prussia, are the richest in the world. The vein of calamine worked by them occurs in the limestone strata of the Condrusian system, and has already yielded more than a million tons of ore. The seam is extremely compact, being only traversed here and there by a few veins of clay, and appears practically inexhaustible. Another deposit, which is found at Welkenraedt, in the same neighbourhood, also belonging to this company, is in some places as much as forty feet thick. The Nouvelle Montagne Company show some very interesting zinc ores as well as blende, galena, and pyrites. They also exhibit sulphide of cadmium and the metal itself, as well as the fume from which it is obtained. The Bleyberg-èz-Montzen Company show zinc and lead ores, and the manufactured metals. The Bleyberg lead mine is said to be the richest in Belgium, and, indeed, in the whole world. The vein, which has already been traced for more than a thousand yards, consists of galena, accompanied with blende, and occurs at the junction of the carboniferous and Condrusian systems. The company also show silver and cadmium, as well as some fine specimens of glass made with the red lead manufactured by them. The French Baccarat Glass Works are supplied largely with the Bleyberg red lead. Montefiore-Levi and Company show a fine series of cobalt and nickel products, including metallic nickel, both commercial and pure, the oxide, the black and red oxides of cobalt, zaffres of various tints, cobalt green, and luteo-cobaltammonia. They also show nickel in bars and plates, nickel alloy in the ingot and in bands for coining, and several statuettes, which certainly entitle this metal and its alloys to rank amongst the artistic metals. From the specimens shown it would appear that only three countries, Belgium, Switzerland, and the United States, have as yet begun to use nickel alloy for their coinage. This alloy, which consists of three parts of copper to one of nickel, was, we believe, originally recommended by M. Stas, as a substitute for the bronze used for the small coins of France and England. Type made from an alloy into which nickel enters is also shown, as well as a series of products illustrating the extraction of nickel and cobalt from their ores in the wet way. In Class 44 there are several exhibitors of rough chemicals, but they do not call for special notice. M. Körner, one of M. Kekulé's chief assistants, exhibits nearly 100 beautifully prepared specimens of phenol derivatives. Some of these are very finely crystallised, notably the orthonitrophenate of methyl, binitrochlorophenol, bromonitrophenol, paraphenolsulphate of copper, phenolbisulphate of potash, and several others. M. Körner's collection is undoubtedly the most complete and interesting show of a purely scientific character in the Exhibition.

Passing onwards to the Prussian department, we find the courts devoted to Class 40 appropriately guarded by two noble lions, one asleep and the other awake, cast at the Royal Prussian Iron Foundry at Berlin. Before the entrance a brass manufacturer exhibits a series of enormous cubes, made of brass plate, piled one on the top of the other, which show graphically the amount and value of the minerals produced in Prussia during the last four decennial periods. The cubes themselves represent the bulk of the gold which was produced by the minerals in each period, one of the sides being divided into spaces representing the amount contributed by each province, another showing in the same way the amount of each description of mineral and metallurgical produce. During the period 1835-45 the minerals produced only £1,000,000, but in 1864 this amount has become nearly septupled. In no part of Europe has the construction of railways been so instrumental in

opening up the mineral resources of the country as in Prussia, as may be readily seen from the above figures. On entering the court the first object that meets our eye is a splendid salt trophy, built up in the form of a grotto, entirely of huge blocks of rock salt from Stassfurth and other localities. Around the base are specimens of kainite, boracite, sylvin, carnallite, and other kindred minerals, found in company with the salt. Close by is a model of the Stassfurth mines, constructed on a very ingenious and simple plan. It consists of a parallelopipedon, formed of glass plates, and is divided transversely and longitudinally with the same material. The base of the model shows the plan of the working, and the various strata are painted on the glass divisions in thin water colour. We shall have more to say of the Stassfurth mines when we come to Class 44, where their produce is exhibited; we therefore pass on at once to the magnificent collection of economic minerals shown by the Prussian Minister of Mines. We have before had occasion to allude in terms of unqualified praise to this splendidly arranged collection, which has been got together under the direction of Dr. Hermann Wedding, of Berlin. It consists of over a thousand specimens, contributed by nearly four hundred mine and quarry owners, and shows at a glance the quality and variety of the mineral riches of the country. To attempt anything like a detailed description of this fine display would be impossible; we must therefore content ourselves with giving our readers an account of the system of classification adopted, and then picking out any specmens that may be of special interest. The specimens, in most cases, are about ten inches long by six broad and three thick; in fact, they are just of a size that allows them to be conveniently handled and examined; they are arranged on shelves one above the other. Attached to each specimen is a number, which corresponds with those of the special catalogue published by the Prussian Mining Department, and which is distributed gratis to all applicants. This catalogue is from the pen of Dr. Wedding, and describes every individual specimen in the fullest possible manner. The descriptions are interspersed with numberless details and statistics of a very interesting character, so that it not only forms a catalogue, but also serves as a succinct history of the mineral resources of Prussia; it is, in fact, one of the best specimens of what a *catalogue raisonné* ought to be. The arrangement commences with coal in all its varieties, from the rich bituminous coal of the Saarbruck and Westphalian districts to the poor lignites found on the borders of the Rhine and the Elbe. Some of the lignite shown is so recent as to be hardly changed in its texture and appearance; indeed, one exhibitor shows a box made of it. The number of specimens of brown coal in the collection sufficiently attests the importance of this branch of mining industry. We, who are accustomed to put a blind faith in bituminous coal, feel somewhat surprised to find that no less than between five and six millions of tons of this mineral were raised in Prussia in 1865, or about half the amount of bituminous coal raised in the same period. Succeeding the specimens of coal are a few samples of turf. Next we have a long series of iron ores of great interest, and one cannot help being struck by the similarity between many of the Prussian varieties and those of our own island. In one part of the collection we have the spathose ores of the Siegen district, closely resembling the Somersetshire varieties, and running, like them, gradually into brown oxide. It is hardly necessary, perhaps, to remind our readers that it is the Siegen ore that produces the famous *spiegeleisen* so much in demand for steel making. We also have red and brown hematite, both massive and botryoidal, clay, ironstone, and black-band, all reminding us of our own varieties of the same ores. Some of the specimens of red hematite from the Harz districts are very fine, and the same may be said of the spathose ore from the Siegen district, some of the specimens of which are almost white. The pisiform ore, which is so common in France, is represented by a few specimens from Holzhausen. It appears to be contained in a calcareous clay matrix, like some of the French varieties. Magnetic ore seems to occur but sparingly. The production of iron ore in Prussia in the year 1865 amounted to nearly two million tons. We next come to the copper ores, the most remarkable of which is the Mansfeld copper slate, which contains workable quantities of silver and selenium. Lead follows next, and then blende and calamine. There are a few specimens of silver ores shown from Andreasberg and Laasphe between the lead and zinc series. After the zinc ores we find cobalt and nickel, antimony, a single specimen of cinnabar, manganese, arsenical pyrites, ordinary pyrites, alum slate, salt and mineral waters, building materials, kaolin and pipeclay, calctuff, chalk, and strontianite. On the walls above the specimens are shown an immense number of maps, sections, and plans. The sections of some of the coal districts are singularly interesting, as showing contortions of strata and faults that would astonish a Welsh or Staffordshire coal-miner. The Wellesweiler coal-field is full of the most extraordinary faults, while those of the Wurm district are more like the teeth of a saw than anything else. The Westphalian coal-measures are waved, like a piece of corrugated iron, and the section of the Maria coal mine reminds one strongly of the conventional zigzags that are generally supposed to represent flashes of lightning. Before quitting this interesting series we must point out the fine collection of coal-measure fossils from Silesia, exhibited by Dr. Göppert, of Breslau. There is also a beautiful little model of a Silesian zinc furnace, which will repay examination. Amongst the private exhibitors we must give the place of honour to M. Krupp, of Essen, whose 1000-pounder gun is one of the wonders of the Exhibition. To the metallurgist the most interesting of the Essen products will undoubtedly be the gigantic ingot of steel shown in the machinery department. When Krupp exhibited a mass of steel weighing only a couple of tons at Hyde Park, in 1851, the metallurgical world would hardly believe that it was possible to cast so large a mass until they saw it before their eyes; but in 1862 he multiplied the two tons by ten, and in 1867 he shows an ingot

weighing twice as much as his last triumph. The mass is in the form of a cylinder, and is forged into an octagon at one of its ends. The top has been smoothed down and polished, to show the texture of the steel, and a piece has been planed and broken out of the middle for the same purpose. The cast-steel rails shown are also of first-rate quality. M. Krupp employs more than 10,000 men at the steel works at Essen and at his collieries and iron mines on the banks of the Rhine and in Nassau. At Essen no less than 1000 tons of coal are consumed daily, and in 1866 61,000 tons of steel of the finest quality were produced. The yearly income of the establishment is something near a million and a half. The works at Essen cover 450 acres, the buildings taking up more than a quarter of this large space. M. Krupp was deservedly awarded the Grand Prix by the jury of Class 40. The show of spiegeleisen from the Siegen and Müsen districts is very fine. We have not room to do more than mention one or two names of exhibitors of this important product. Amongst the best specimens are those of the Cologne-Müsen Company, who work the famous Stahlberg mine. The specimens shown by them are amongst the finest ever exhibited, the crystals being in many cases several inches long. The Stahlberg mine is one of the largest in Germany, and yields 100,000 tons per annum. The ore approaches in composition to the best specimens of Somersetshire ore, but contains more manganese than the English variety. The following is the analysis given by the company:

Protocarbonate of iron	74·47
Protocarbonate of manganese ...	17·08
Carbonate of lime	1·34
Carbonate of magnesia	5·75
Insoluble............................	1·08
Moisture	0·09
	99·81

Some of the specimens of spiegeleisen made from this contain between 9 and 10 per cent. of manganese. The annual production of steel pig from coke is 34,000 tons, that from charcoal 6000 tons. In addition to a large series of specimens illustrating their iron manufactures, the company show lead, copper, and silver, and the ores from which they are obtained. The galena from the Schwabengrube yields 50 per cent. of metallic lead, and 0·134 per cent. of silver. The Vorwaerts Company, Messrs. Schneider, Kreutz, Fromberg and Wildt, Dressler, and the George Maria Company, also show splendid specimens of this iron. The Hörde Company exhibit a fine series of girders and rolled work generally, made from red hematite iron. The Phœnix Company also show fine specimens of iron from the same source. Amongst the other exhibitors of iron and steel we must mention the Bochum Company, who show in the machinery gallery twenty-three steel railway wheels, cast in a single piece; and Borsig, who exhibits some fine blooms of steel, weighing a ton each. The exhibitors of copper are very numerous; we can only, therefore, notice the Mansfeld Company, who show some fine specimens of copper-slate ores, rose copper, silver, and selenium. The minerals used by this company are the copper-slate, found under the magnesian limestone of the Harz, also gravelly ore from the new red sandstone, lying immediately below the copper-slate. They both contain silver and selenium in notable proportions. Of the latter element a splendid specimen is exhibited, cast in the form of a dolphin, standing nearly a foot high. They also exhibit a number of specimens of manufactured copper, notably an enormous hammered pan, for use in the beetroot sugar manufacture, eight and a half feet in diameter and three feet deep. Amongst the specimens shown by the Clausthal Royal Mines, in the Upper Harz, are to be found a splendid series of artificial arsenic, antimony, and sulphur compounds, beautifully crystallised. They have been found at various times in the chinks and crannies of the furnaces. The Mederfischbach Company show a beautiful sample of sprouted silver. The Royal Saxon Foundry, at Freiberg, makes a very beautiful display of gold and silver, cut so as to show the bubbles formed during "sprouting" in section, cadmium, two ingots of indium at least four inches long, zinc, lead, nickel, bismuth, some brilliantly white arsenious acid, realgar, bitument, and litharge. The ingots of indium attract great attention, but they are unfortunately placed so high as to render examination impossible. The Royal School of Mines at Freiberg shows a series of minerals classified and arranged systematically, also sets for the blow-pipe, which are sold at a very cheap rate. The Saxony Blue Company show some beautiful specimens of cobalt and nickel colours and compounds. Gunicke, of Naumburg, exhibits nickel and its ores. The Naumburg nickel works are amongst the largest in Germany, producing annually more than 65,000 lb. of the metal and 82,000 lb. of its oxide. Zinc is shown by the Silesian Company, who, besides numerous specimens of the metal worked into every possible form, exhibit an immense rolled plate weighing upwards of a ton and measuring 5·35 metres long by 1·43 metre broad and 0·20 mm. thick.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,
AND E. J. MILLS, D.SC.

On Certain Derivatives of Paraoxybenzoic Acid. *By* A. Ladenburg and A. Fitz.*

This paper is a continuation of one already noticed.†

Anisic acid may be conveniently prepared from anisol by placing the latter substance for a few minutes in contact with a mixture of five parts of potassic chromate (dichromate?), ten of hydric sulphate, and twenty of water, at 50°. The acid formed may be separated from the chrome-alum thus produced by solution in ammonia, and the ammoniacal salt yields a precipitate of the free acid when hydric

* 'Ann. Ch. Pharm.,' cxli, 247.
† See Lab., Aug. 24, p. 373.

chloride is added. When anisic acid is heated with excess of aqueous hydric iodide (boiling at 127°), methylic iodide distils away and paraoxybenzoic acid remains behind.

Paraoxybenzoic acid forms two groups of ethylated derivatives, containing respectively one and two alcohol radicals in the molecule. The first group is subdivided into two others, in one of which the alcohol radical takes the place of the hydrogen of hydroxyl, while in the other substitution is made for the hydrogen of the radical (CO_2H). The members of the former subdivision constitute true monobasic acids, and include anisic acid, while the latter are almost neutral bodies, analogous to phenol. The ethers of paraoxybenzoic acid, which contain two alcohol radicals, are prepared by the action of alcoholic iodides on the dibasic salts of that acid. On saponification an exchange is effected on the radical contained in the group (CO_2H), anisic and ethyl-paraoxybenzoic acids being thus produced. The ethers which contain one alcohol radical are obtained by treating the monobasic salts with alcoholic iodides.

Monomethylic paraoxybenzoic acid is formed by heating paraoxybenzoic acid, potash, and methylic iodide, to 120° in sealed tubes:

$$C_7H_6O_3 + KHO + CH_3I = C_7H_5(CH_3)O_3 + KI + H_2O.$$

When the reaction has terminated the contents of the tubes are treated with water; the insoluble part is dried in the air and submitted to distillation. The distillate is the ether desired. It is insoluble in cold water, sparingly soluble in hot water; in alcohol or ether it readily dissolves. The new ether fuses at 17° and boils at 283.° It is isomeric with anisic acid, monomethylic salicylic acid (oil of *gaultheria*), and methyl-salycylic acid; also with benzol-formic, phenoxacetic, and cresotdic acid. The corresponding amide is readily formed by heating the acid with strong aqueous ammonia to 100°. It crystallises in long white needles, and has already been observed by Griess.* The monoethylic ether boils at 300°, without decomposition.

Methylic methyl-paraoxybenzoic acid is prepared in accordance with the following equation:

$$C_7H_6O_3 + 2CH_3I + 2KHO = C_7H_4(CH_3)_2O_3 + 2KI + 2H_2O;$$

it may be purified by distillation. The acid is white and crystalline, fuses at 45°, and boils at 255°. It had previously been obtained by Cahours.† On treatment with strong aqueous or alcoholic potash, or with *one* molecule of hydric iodide, it yields anisic acid. The diethylated body corresponding to this is an oil heavier than water, and boiling at 275°. When saponified with potash it produces ethyl-paraoxybenzoic acid, isomeric with ethylic paraoxybenzoate, ethyl-salicylic acid, ethylic salicylate, the two ethylated derivatives of oxybenzoic acid, and the dimethylated derivatives of the three oxybenzoic acids, and, lastly, with phloretic acid, cresoxacetic acid, as well as with an acid obtained by Cannizzaro when acting on anisylic cyanide with potash. Cannizzaro's compound is methyl-paraoxy-(α)-toluylic acid, and its relation to ethyl-paraoxybenzoic acid is shown by the formulæ—

$$C_6H_4\begin{cases}OC_2H_5\\CO_2H\end{cases} \qquad C_6H_4\begin{cases}OCH_3\\CH_2CO_2H\end{cases}$$

Ethyl-paraoxybenzoic acid. Methyl-paraoxy-(α)-toluylic acid.

Sodic ethyl-paraoxybenzoate crystallises in well-developed tables, very similar in form to the sodic salt of anisic acid. Both salts are best crystallised by spontaneous evaporation, and are very efflorescent. The calcium salt is precipitated when a solution of calcic chloride is added to one of the sodic salt; it is white and minutely crystalline, little soluble in cold, more soluble in hot water. At 150° it is anhydrous, and has the formula—

$$(C_9H_9O_3)_2Ca.$$

The barium salt is very similar to the calcium salt; it is anhydrous at 100°. The lead salt crystallises in white lustrous leaflets, soluble in hot water. The silver salt is quite insoluble in water, and has the formula—

$$C_9H_9AgO_3.$$

Paraoxybenzoic acid, if treated with phosphoric pentachloride, forms a chloride analogous to that obtained in like manner from salicylic acid; and the new chloride, in presence of water, yields the chlorodracylic acid of Beilstein and Schlun.

[The combustions incidental to this research have a special analytical interest, having been all performed, according to Ladenburg's method,* with argentic iodate and hydric sulphate.]

On Mellitic Acid. By A. Baeyer.†

A series of experiments which the author has not yet concluded have already furnished the following results. Mellitic acid is a hexbasic acid, and has the composition of benzol, in which six proportions of carboxyl have been substituted for six of hydrogen—

$$C_6(CO_2H)_6.$$

On heating with lime it is completely resolved into carbonic acid and benzol. Sodium amalgam converts mellitic acid into a hexbasic acid—$C_6H_6(CO_2H)_6$—which, if heated with hydric sulphate, becomes the tetrabasic acid $C_6H_2(CO_2H)_4$. To this $2H_2$ can be added, and more carbonic acid may be removed by hydric sulphate. *Benzoic* acid is thus the last stage of the transformation.‡

On the Estimation of Free Acid in Commercial Sulphate of Alumina. By C. Giseke.§

The author's method consists in dissolving a known weight of the sample in water and determining the free acid with standard solution of soda, *logwood extract* being used as an indicator. When the extract is added to a neutral solution of sulphate of alumina, or of potash- or ammonia-alum, a very characteristic deep violet-red is produced; if free acid be present only a pale brownish-yellow appears.

In practised hands the results are accurate.

* 'Zeit. Chem.,' 1861, 1.
† 'Journ. f. Prakt. Chem.,' xxxvi, 429.

* 'Ann. Ch. Pharm.,' cxxxv, 1.
† 'Ann. Ch. Pharm.,' cxli, 271.
‡ 'Prof. Baeyer is very anxious to obtain a supply of mellite from any chemist who can spare it.
§ 'Ding. Polytech. Journ.,' clxxxiii, 40.

EDITORIAL NOTES.

SAFETY-VALVES.

THERE is a very great want among scientific men of some means of letting off their superfluous energy. In some departments of learning the complaint is of a lack of power; there the mental flywheels turn round lazily for want of steam. But in scientific men, working as they do at high pressure, it is the excess and not the lack of steam that is troublesome. In some intellects the generation of steam is out of all proportion to the machinery. If we may be allowed to coin a word, such minds are extremely 'boilerous,' and a fizzing sound of pent-up steam goes with them wherever they go. In politics, parliament and the platform favour the escape of any amount of superabundant gas; but in science we have no institutions of the kind. The Royal Society would be denying its parentage if it for a moment favoured any exciting discussion sure nearly to lead to no definite conclusion; while in the less noble societies the chairman and the time nip all oratory in the bud before it has begun to bloom. The consequence is that there is a rush to the periodicals and to the magazines, and scientific literature is burdened with controversies which last a twelvemonth in print, but which would have begun, flourished, and ended in a couple of days at most had the combatants been able to have met in a good face-to-face fight. All controversies are much better spoken than written. On a platform, to be cheery and good-natured is to have half won the battle; the written rejoinder rarely fails to be a medium for those scathing repartees and pungent personalities which come into the mind, often as isolated thoughts, in the night-watches or at the hour of shaving. Scientific men have a reputation for being snarling and ill-natured in their literary altercations, and we believe this arises in great part from their being too much confined to print, and from their having but few opportunities of letting off their pent-up feelings in a real formal debate.

For all this superfluous energy and superabundant controversial steam it appears to us the British Association for the Advancement of Science might be made a very useful safety-valve. And it is certain that the Public of Temporary Associates and other Dilettanti who enter once a year into the Temple of Science, and whose opinion, in addition to their presence, determines whether the meeting is a success or not, enjoy animated debates infinitely more than a series of even new and profound papers. Very instructive is the task of standing at the door of Section B and watching the behaviour of the, chemically speaking, Philistines who drop in to see what is going on. They gaze with wonder at Mr. Bore, who is reading his analysis of a new mineral just arrived from Weisnichtwo, giving full details up to the third and fourth decimal. Their eyes rest for a moment on the painfully attentive chairman, who feels that if he does not listen no one else will, on the secretaries busily engaged in their private correspondence, and on the handful of an audience, of whom those only are attending to the speaker who do not understand him, and therefore wish it to be thought that they do—and having stayed as long as they think is necessary for decorum's sake, depart on tiptoe, wondering what manner of men these Section B men be. Or, perhaps, it is Professor Item, who is once more developing the views which he has already dragged through two or three learned societies and three or four journals; and even the chairman himself is gaping.

How much better for the public outside chemical science, how much better for vivacious and argumentative young chemists, and how very much better for scientific literature, it would be if these meetings in Section B were made occasions for getting through all the discussions and differences of the year in a few fair and yet formal debates. Of course, even as things are now, very lively passages of arms frequently occur; but when they do take place it is by haphazard mostly, and through no concert. Generally, when one champion is anxious to provoke a dispute his proper antagonist is not in the room, having wandered away to some other section or pleasure. And in many cases the chairman feels bound to put an end to the very beginning of strife, on account of the long list of important papers promised by impatient people whose names are written in the day's programme. What is wanted is a thoroughly organised debate, in which every one who pleases to speak sense may have a fair hearing, while the chief men take care to keep the audience to the real question at issue, and by sound and pregnant speeches to quench the flame of conceit, and to expose the folly of the foolish. It is not to be expected that those who take one side of a question will succeed in convincing and converting those who take the other. As far as we know, this never was the result of any debate that was ever debated, and can hardly be put forward as an object. But both sides will have an opportunity of proving that they and they only are in the right. And if any one afterwards tries to renew the discussion by a long paper in any periodical, it will be taken as a sure sign that he at least is in the wrong.

MICHAEL FARADAY

WAS a native of the metropolis, having been born in the parish of Newington on September 22, 1791. The son of a Yorkshireman, who gained his livelihood in London as a working smith, young Faraday's education was of the most rudimentary description. At a common day school, and at a time when the teachers of these establishments possessed but a slender stock of erudition, the future philosopher picked up some knowledge of reading, writing, and arithmetic. He appears to have remained at school until his thirteenth year; and small as were his opportunities for the acquisition of knowledge, the innate penetration of his mind, his natural habit of close and accurate observation, as well as his passion for reading, compensated in a very high degree for the restricted school education of the blacksmith's son.

Accordingly, when at thirteen he was apprenticed to Mr. Riebau, of Blandford Street, bookbinder, we may fairly assume that he was master of a greater store of learning than the majority of more favoured youths of the same age. At what period during his term of apprenticeship his mind took a decided bent towards scientific knowledge does not positively appear, but we have it on record that during this interval his little leisure and his slender store of pocket-money were devoted to the acquisition of books and apparatus necessary for the investigation of natural science.

Among other books he was the happy owner of such treasures to his enthusiastic nature as the treatise on electricity reprinted from the 'Encyclopædia Britannica' and Mrs. Marcet's 'Conversations on Chemistry.' The treatise taught him how to make an electrical machine, and his first effort in this way was made with the aid of a common glass phial. Growing more ambitious as his laborious days and months stole on, he improved on his first rude apparatus by making a second electrical machine with a proper cylinder; and his humble studio presently came to be embellished with a variety of other pieces of apparatus requisite for the study of electricity. In the short hours of his leisure he turned these tools to the best account, and the plain bookbinder's boy became the proud possessor of all the knowledge then before the world relative to electrical force.

A circumstance sufficiently unlooked for—one almost to be deemed accidental—enabled young Faraday to plant his foot upon the portals of the Temple of Science. Among Mr. Riebau's customers was Mr. Dance, of Manchester Street, a Member of the Royal Institution. This kind-hearted scientific amateur noticed what the young bookbinder was doing, and obtained permission for him to attend the last four lectures delivered in the Royal Institution by Sir Humphry Davy in the months of February, March, and April of the year 1812. This, the first great event in Faraday's career, is best described by himself, in a letter to Dr. Paris, in answer to an application for a statement of the circumstances by which he became connected with the Royal Institution. We append his letter—a charming autobiographical bit—in which he reveals to Davy his aspirations towards a scientific career. It is a matter of great regret that we have not much more information of a similar kind, as to Faraday's early youth.

To J. A. PARIS, M.D.

Royal Institution, Dec. 23, 1829.

MY DEAR SIR,—You asked me to give you an account of my first introduction to Sir Humphry Davy, which I am very happy to do, as I think the circumstances will bear testimony to his goodness of heart.

When I was a bookseller's apprentice I was very fond of experiments and very averse to trade. It happened that a gentleman, a Member of the Royal Institution, took me to hear some of Sir H. Davy's

last lectures in Albemarle Street. I took notes, and afterwards wrote them out more fairly in a quarto volume. My desire to escape from trade, which I thought vicious and selfish, and to enter into the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy, expressing my wishes, and a hope that if an opportunity came in his way he would forward my views. At the same time I sent the notes I had taken at his lectures.

The answer, which makes all the point of my communication, I send you in the original, requesting you to take great care of it and to let me have it back, for you may imagine how much I value it.

You will observe that this took place at the end of the year 1812, and early in 1813 he requested to see me, and told me of the situation of assistant in the laboratory of the Royal Institution, then just vacant.

At the same time that he thus gratified my desires as to scientific employment, he still advised me not to give up the prospects I had before me, telling me that science was a harsh mistress, and in a pecuniary point of view but poorly rewarding those who devoted themselves to her service. He smiled at my notion of the superior moral feelings of philosophic men, and said he would leave the experience of a few years to set me right on that matter.

Finally, through his good efforts, I went to the Royal Institution early in March of 1813, as assistant in the laboratory; and in October of the same year went with him abroad as his assistant in experiments and in writing. I returned with him in April, 1813, resumed my station in the Royal Institution, and have, as you know, ever since remained there.

I am, dear sir, very truly yours,

M. Faraday.

The following is the note of Sir Humphry Davy alluded to in Faraday's letter:

To Mr. Faraday.

Sir,—I am far from displeased with the proof you have given me of your confidence, and which displays great zeal, power of memory, and attention. I am obliged to go out of town, and shall not be settled in town till the end of January. I will then see you at any time you wish.

It would gratify me to be of any service to you. I wish it may be in my power.

I am, sir, your obedient humble servant,

H. Davy.

The quondam bookbinder's apprentice was now an apprentice to Science; but his early studies at the Royal Institution were interrupted for an interval in the autumn of 1813. Sir Humphry Davy was anxious to visit the South of France and Italy, but France and England were then at war, and Napoleon had refused to grant a passport to some of the most illustrious English noblemen who had asked for it. The great soldier was, nevertheless, an admirer of scientific genius, and the favour he refused to social rank he accorded to mental grandeur. Moreover, the French Institute represented to its august master the importance of Sir Humphry Davy's great discovery relative to the decomposition of the alkalies and earths, and its bearings upon the philosophy of volcanic action. The imperial soldier thereupon granted his passport to the celebrated English chemist, who had expressed a desire to visit the extinct volcanoes of Auvergne, preparatory to examining the one which was in an active state at Naples.

The Emperor's pass secured, the party set out in October, 1813. It consisted of Sir Humphry and Lady Davy and Michael Faraday. Embarking at Plymouth in a cartel, they set sail for the opposite shore, and landed at Morlaix, in Brittany. But no sooner had they touched French soil than they were arrested by the authorities of the town, who, doubting the authenticity of the papers presented by the foreigners, detained the travellers. In a week instructions came from Paris, and the party was allowed to proceed on its journey. Sir Humphry reached the capital of France on the 27th. In Paris the English chemist was most

cordially welcomed by Guyton de Morveau, Vauquelin, Cuvier, Humboldt, Gay-Lussac, Berthollet, Laplace, and Chaptal, and we may easily conceive the delight that Faraday, the humble but enthusiastic follower of the great Englishman, received on being allowed to see and hear these masters of science.

With Davy, he set out from Paris on the 23rd of December, on the way to the South of France and Italy. After exploring the extinct volcanoes of the mountainous region of Auvergne, they proceeded southward and crossed into Italy by the way of Nice and the Col de Tende; thence to Turin, next to Genoa; Florence and Rome came afterwards, then Naples, where the most important volcanoes were explored. Returning northwards, they passed through Milan on their way to Switzerland. At Milan Faraday saw Volta, then a very old man. The summer was spent at Geneva, the autumn partially in the Tyrol, the ensuing winter at Rome. Finally, after an absence of two years, Sir Humphry returned home through the Tyrol and Germany. This long interval had not been entirely devoted to sightseeing and shifting from place to place; Sir Humphry laboured constantly, and his assistant laboured and learnt incessantly.

Resuming his post at the Royal Institution, Faraday, during the following five or six years experimented patiently and with a perfectly clear perception of results, making no sign to the outer world and disregarded by it, but earning the esteem of his patron, and laying the broad foundations of that knowledge which hereafter was to make him so famous.

In the year 1820 he came before the world with an account of his discovery of the chloride of carbon. At this period Œrsted gave forth his discovery of the relation between electricity and magnetism; Faraday employed himself upon the subject, and in the following year published his ideas in two papers, entitled respectively "New Electro-magnetic Motions" and "A Theory of Magnetism." The attention these articles met with spurred on the young chemist to further exertions, and in 1823 we observe him communicating to the world, through the medium of the 'Philosophical Transactions,' his experiments "On the Condensation of Muriatic Acid into the Liquid Form." In 1823 the Academy of Sciences of Paris inscribed his name in their archives as corresponding member.

In the year 1824 he married Miss Barnard, the daughter of a silversmith in Paternoster Row.

In the year 1829, after a long series of laborious experiments on the production of optical glass, he read before the Royal Society the Bakerian lecture, called "On the Manufacture of Glass for Optical Purposes."

In the year 1831 he commenced the publication of his celebrated 'Researches in Electricity.' These researches won for him the fame of being one of the greatest investigators of natural laws the world has ever seen. "These papers have been almost regularly published (two in the course of each year) from that time to the present [1831—1852], and there is not one of them that does not contain either a discovery of importance, or a criticism arising out of some original discovery upon the labours of others. These papers embraced the wide subject of electricity. To ascertain the nature of this fòrce—to evolve the laws which it obeyed—to exhibit the modes of its development, and its relations to heat, light, and the other great forces in nature—were the objects of these papers. If Faraday did not discover the Science of Electro-magnetism, he established its laws, and made the Science of Magneto-electricity. If the thought that the phenomena of free electricity, galvanism, and magnetism, were merely modifications of the same force was not originally his, it has been mainly through his experiments that it has been demonstrated to be true."*

In consequence of the publication of the earliest series of these researches the University of Oxford, in 1832, conferred on their author the honorary degree of Doctor of Civil Law. In the same year he received the Copley medal of the Royal Society for his discovery of magneto-electricity. In the following year Mr. Fuller, a prosperous scientific amateur, founded the Chair of Chemistry in the Royal Institution, at the same time making known his express wish that Faraday should be named the first Fullerian professor, and should retain the chair as long as he should remain attached to the institution, without being required to deliver lectures or having any other duties exacted from him, in consideration of his valuable services in the cause of science. Towards the close of the year 1835 the government of Lord Melbourne testified their recognition of the philosopher's labours by conferring upon him a pension of £300 per annum. In 1838 he again received the Copley medal of the Royal Society, for his researches in Specific Electrical Induction. In 1846 he received, simultaneously, the Royal and the Rumford medals in recognition of his discoveries of dia-magnetism, and the influence of light upon magnetism. The magnetic character of oxygen and the magnetic relations of gases and flames were disclosed by Faraday in 1847.

* 'Eng. Cyclo.,' art. "Faraday."

In addition to his other duties, Faraday, during the interval 1829—42, was chemical lecturer to the cadets at the Royal Military Academy at Woolwich, and subsequently he accepted the post of scientific adviser on Lights to the Board of Trade.

Ever since the year 1827, when he first appeared at the lecture table of the Royal Institution, he had every year delivered lectures until 1861, when, in concluding his discourse on platinum, he made use of these affecting terms:— "The gradual loss of memory and of my other faculties is making itself painfully evident to me, and requires, every time I appear before you, the continued remembrance of your kindness to enable me to get through my task. If I should happen to go on too long, or should fail in doing what you might desire, remember it is yourselves who are chargeable, by wishing me to remain. I have desired to retire, as I think every man ought to do, before his faculties become impaired; but I must confess that the affection I have for this place, and for those who frequent this place, is such that I should hardly know when the proper time has arrived."

The time had, indeed, arrived when the great teacher—the gifted lecturer—was to leave the scene of his triumphs. These pathetic words were the last public utterances of the philosopher within the walls of the Royal Institution. In this laboratory, during a period of more than half a century, the researches of Davy, Brande, Faraday, and Tyndall, have been prosecuted. The laws of electro-chemical decomposition, the decomposition of the fixed alkalies, the establishment of the nature of chlorine, the philosophy of flame, the condensibility of many gases, the science of magneto-electricity, the twofold magnetism of matter, comprehending all known substances, the magnetism of gases, and the transmission of heat through gases, are the results of investigations carried on in this laboratory.*

Faraday himself has given us a sketch of the rise of the admirable institution which has been designated as "the Workshop of the Royal Society." He says, "According to the earliest document I can find, the first meeting held for the purpose of founding the institution was on the 9th March, 1799, at the house of Sir Joseph Banks, in Soho Square. It is called a meeting of the managers, and there were present Sir Joseph Banks, the Earl of Morton, the Earl Spencer, Count Rumford, Richard Clark, Esq., and Thomas Bernard, Esq. These were the men; and at the meeting they made Sir Joseph Banks Chairman, and Mr. Bernard Secretary. The title and purposes of the institution, as given at that time, are as follows:— 'Institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching, by courses of philosophical lectures, the application of science to the common purposes of life.' You will see that no idea of the science that grew up in the time of Young and Davy entered into the conception of the founders. The first meeting of the proprietors (now replaced by those we call members) took place on the 20th April of the same year."*

Though averse to the ordinary distinctions of society, and having no hankerings for places and honours, Faraday was in a measure compelled to accept some acknowledgments of his great abilities—he was chosen by the Academy of Sciences of Paris to succeed Dalton as one of the eight foreign associates of that body. By a singular coincidence the three associates whose names succeeded his were English. They were Sir D. Brewster, Sir John Herschell, and Richard Owen. He was likewise a Member of the Senate of the University of London, a Fellow of the Royal Society, a Knight of the Prussian Order of Merit, a Commander of the Legion of Honour, Corresponding Member, etc., of the Royal and Imperial Academies of Science of Paris, St. Petersburg, Florence, Copenhagen, Berlin, Gottingen, Modena, Stockholm, Palermo, Turin, Brussels, etc. etc.

A tribute to the memory of the great English *savant* has been penned by the eminent French chemist, M. Ste.-Claire Deville, who, in the introduction to his edition of the 'Chemical History of a Candle,' says—"Michael Faraday is the grandest scientific figure of the time. This is owing principally to two causes. In the first place, his inventive genius in theory is assisted by his power of proving his theories by the aid of experiment. The apparatus in physics which he contrived having been utilised almost immediately after he had described them, his name became popular at the same time that his grand discoveries were making him the admiration of the scientific men and of the learned bodies of all nations. In the second place, the grandeur and the simplicity of his character, the unalterable purity of his scientific life, the sincere love for the well-being of his fellow-creatures, which he has ever practised with all the ardour of his nature—all these qualities and all these virtues have drawn from his compatriots and from the many foreigners who have visited him an admiration with which none could help being animated. . . . After our Universal Exhibition of 1855, if my memory

* 'Report of Royal Institution,' 1863.

* Extract from a letter to C. R. Weld, Esq., who prints it in his 'History of the Royal Society.'

rightly serves me, Faraday paid a visit to Paris. . . . . The Royal Institution of London is one of those private establishments, numerous in England, wherein learned men, men of the world, the nobility, are banded together for the advancement of science, for the setting aside considerable sums of money for the prosecution of a particular line of research by certain professors, and for disseminating a knowledge of science by lectures, at the same time elementary and elevated in their nature. The most distinguished audiences assemble in the great theatre of the Royal Institution, to listen to the expositions of science given by the most eminent men in England, and very often foreign *savans* receive there the noblest reception. I am in a position to speak thus positively, as I have myself been a witness to these interesting scenes—scenes which I can never forget.

"When Faraday is at the lecture table, all that he says is immediately understood and accepted with admiration. . . . . I do not know how better to compare a lecture by Faraday at the Royal Institution than with the execution of a symphony by Mozart or Beethoven before the enthusiastic auditory of the Conservatoire. . . . . . Should a stranger meet with the good fortune I have enjoyed, to work in the laboratory of the great man, Faraday will overload him with courtesy and attentions. I have seen in this laboratory the most illustrious statesmen of England treat Faraday with that respectful familiarity which is indicative of reciprocal esteem. One day I took part in a remarkable conversation in which Faraday's interlocutor was the lamented Prince Albert. My host's courtesy caused this conversation to be carried on in French. It is impossible for me adequately to express the admiration I felt for the illustrious *savant* and his august visitor. The latter—in language evincing sound sense and moderation of views, and in which the delicate shades of expression belonging to our language were used marvellously well—extolled our state of system of teaching. Faraday sustained, with mild yet inflexible energy, the English system of absolute liberty. I came to the conclusion that a prince, so wise and so wisely counselled, could scarcely remain long in error. . . . . Constructing for himself, when young, the instruments of which he stood in need, he acquired an incomparable degree of cleverness, which became a very precious gift to him when, in after years, he had occasion to invent new pieces of apparatus, and a prodigious dexterity in handling his instruments when he had need to show them in public. . . . Faraday remained all his life at the Royal Institution, refusing the most lucrative posts, and even the title of baronet, a distinction so eagerly sought after in England. . . . . Faraday never allowed a question to remain in suspense; he always required that it should be answered by a fact or a series of facts, which should resolve the problem either in a negative or a positive sense. His preconceived ideas of the phenomena of nature have always been his guide, but have never brought his mind under bondage. Daring in his attempts, for, as he has himself said to me, that which is apparently absurd is not always impossible, he astonishes us by his inventions; but ever prudent in his conclusions, he always proves all that he has affirmed."

Desirous of presenting our readers with a characteristic portrait of Faraday, we have reproduced a celebrated sketch of the great philosopher which appeared in 'Fraser's Magazine' in February, 1836. We have selected this sketch, instead of making a copy from a modern photograph, because of its vigour and truth to nature; it is, besides, rarely to be met with at the present day, whilst every one can anywhere purchase for himself one out of the several portraits of Faraday which photographers are now putting forth. The sketch is designed by Croquis, which was the soubriquet under which, at the time this portrait appeared, the celebrated painter Daniel Maclise chose to disguise himself.

Appended to the sketch was an equally characteristic bit of writing, from the pen of the lively and witty Dr. Maginn. We give a few excerpts from it:

"Here you have him in his glory. . . . Here you have him as he first flashed upon the intelligence of mankind the condensation of the gases or the identity of the five electricities. Here stands—anno ætatis 42—at the head of one of the noblest of the sciences—honoured as the compeer of Cuvier, Laplace, and Buckland—the son of a poor blacksmith, who was apprenticed at nine years of age to an obscure bookbinder in Blandford Street, and earned his bread by that humble calling until he was twenty-two! There are spectacles on which, of all that history presents, we dwell with the highest exultation. . . . . Ned Magrath, now Secretary to the Athenæum, happening five-and-twenty years ago to enter the shop of Riebau, observed one of the bucks of the paper bonnet zealously studying a book he ought to have been binding. He approached; it was a volume of the old 'Britannica' open at the article "Electricity." He entered into talk with the greasy journeyman, and was astonished to find in him a self-taught chemist of no slender dimensions. He presented him with a set of

tickets for Davy's lectures at the Royal Institution, and daily thereafter might the nondescript be seen perched, pen in hand, and his eyes staring out of his head, just over the clock opposite the chair. At last the course terminated; but Faraday's spirit had received a new impulse, which nothing but dire necessity could have restrained; and from that he was saved by the promptitude with which, on his forwarding a modest outline of his history, with the notes he had made of these lectures, to Davy, that great and good man rushed to the rescue of kindred genius. Sir Humphry immediately appointed him an assistant in the laboratory; and after two or three years had passed he found Faraday qualified to act as his secretary. The steps of his subsequent progress are well known. He travelled over the Continent with Sir Humphry and Lady Davy, and he is now what Davy was when he first saw Davy—in all but *money*. And money, too, now that he has a nest-egg, will accumulate. We should be sorry to bet a dozen of champagne that, ere ten years more elapse, he will not be Sir Michael. . . . . The future baronet is a very good little fellow, a Christian, though, we regret to add, a Sandemanian (whatever that may signify), playing a fair fork over a leg of mutton, and devoid of any reluctance to partake an old friend's third bottle."

The above is a somewhat apocryphal version of the philosopher's early career. The only accurate bit in the sketch, as it appears to us, is the description of the earnest, absorbed student taking notes from Davy's lectures. The "old friend's" third bottle could have no other origin than in the brain of the humorous Hibernian LL.D. that penned the article. It is, however, quite true that Faraday belonged to the religious sect called Sandemanians or Glassites, a body which at the present day numbers about a dozen congregations throughout Great Britain, comprehending upwards of 2000 persons. The sect was founded in Scotland in 1728 by Mr. Glass, a minister of the Scottish Established Church, whose opinions on church government approached very closely to those of the Congregationalists. About 1757 Robert Sandeman appeared as an advocate of the same opinions, and some years afterwards he organised a congregation.

During the last years of the philosopher's life he resided at Hampton Court Palace, where in 1858 Her Majesty had allotted him apartments. Between this place and his old beloved scientific home in Albemarle Street the aged man was constantly going backwards and forwards, until the opening months of the year 1861, after which his old haunt knew him not, and he retired to Hampton Court, where his closing years ebbed away, and on Sunday, August 1[illegible] at the age of 76, Michael Faraday died.

Faraday's principal writings are—

'Chemical Manipulation: being Instructions to Chemical Students in the Method of Performing Experiments of Demonstration or of Research with Accuracy and Success.' Three editions of this book have been published; the first appeared in 1827.

'On the Practical Prevention of Dry Rot in Timber.' Published in 1833.

'Experimental Researches in Electricity.' Volume I, published in 1839, contains the fourteen series of "Experimental Researches" which were printed in the 'Philosophical Transactions' in 1831—38.

'Experimental Researches in Electricity.' Volume II, containing all the papers on the subject printed in the 'Phil. Trans.,' the 'Phil. Mag.,' and the 'Quarterly Journal of Science,' in 1838—43.

'Experimental Researches in Electricity.' Volume III, containing reprints from papers communicated to 'Proceedings of Royal Institution,' the 'Philosophical Transactions,' and 'Phil. Mag.,' in 1846—52.

'Experimental Researches in Chemistry and Physics,' containing all the researches in these branches of science contributed by him to the 'Phil. Trans.,' the 'Journ. of the Roy. Inst.,' the 'Phil. Mag.,' and other publications, in 1821—57.

PERSONAL RECOLLECTIONS.

An eminent *savant*, who commenced his scientific career as "Laboratory Assistant" under Brande and Faraday, has kindly placed in our hands an interesting account of the inner life of the Royal Institution from 1820 to 1825, the period of Faraday's most active researches. The entire manuscript cannot be printed in these columns, as it would take up more space than we have at our disposal, but we trust that it will not long remain unpublished. The author having given us permission to make what use we can of his "Recollections of the Laboratory of the Royal Institution," we gladly append to our own imperfect memoir of Michael Faraday a few extracts which touch upon the work and habits of the great discoverer who has just passed away.

FARADAY AS CHEMICAL ASSISTANT.

When the writer obtained his appointment at the Royal Institution, in 1820, Sir Humphry Davy was Honorary Professor, and Mr. Brande Acting Professor of Chemistry. Mr. Faraday was the Chemical Assistant; while the writer, then a lad of fourteen, rejoiced in the title of Laboratory Assistant. Faraday occupied rooms on the second floor at the institution, and dined daily at one o'clock at an eating-house in

Marlborough Street. When not engaged in assisting Professor Brande at the lecture table, or in preparing illustrations for coming lectures, he generally found ample occupation in making various chemicals not easily procured, and the contents of the lines of bottles on the shelves of the laboratory testified to his skill and industry. The few hours of leisure that he enjoyed were devoted to original research.

A LEGAL CONTEST.

In 1821 there was an important trial—"Severn and King (sugar-bakers) *v.* The Imperial Insurance Company"—involving claims on account of a fire. Brande was engaged as a witness on one side, Faraday on the other, and each made experiments to back up his views. The side Faraday was on won.

THE HOUSEKEEPER'S OPINIONS.

Mrs. Greenwood, the housekeeper of the institution, a Yorkshirewoman, would often talk to the writer of past times, when crowds of great people attended Davy's lectures, and the lines of carriages extended all down Albemarle Street into Piccadilly. "Ah, William," she would say "Sir Humphry *is* a great man, a wonderful man! He made our institution. Mr. Brande is the kindest man alive, so gentle and always so nicely dressed. He lectures beautifully, and any one can understand him. But there are not the strings of carriages in the street as in former times, and the institution is not so rich as it used to be." Mrs. Greenwood had a high opinion of Faraday, whom she affectionately called "Mickey," he was so steady and persevering. She was quite sure that he would be another great man, and was not surprised to hear that *some* people were a little jealous of him. This good woman was a Methodist, and could she have had Davy, Brande, and the writer, in the same fold with herself, her happiness would have been complete. "Ah!" she would exclaim, "what is the use of all this science, all this strange brain-work, all this to-do, if you are not sure of salvation? Sir Humphry and Mr. Brande are Episcopalians, and have chosen, I fear, but a sorry road to heaven. Mickey belongs to the Sandemanians, who have got a chapel in the City; and I hear that when they have done praying and discoursing they all dine together in the very chapel—a curious sort of religion that! And as for you, William, I don't think you get much good from the chapel opposite, for you spend your Sunday afternoon in drying plants and reading about botany."

A GREAT DISCOVERY—HOW CELEBRATED.

In the autumn of 1821 Faraday repeated with great care the experiments of Ampère on the mutual action of magnets and electric currents, and was eventually led to the discovery of electro-magnetic rotations. The experiments were mainly carried on in the battery-room, Hare's calorimeter being much used as the source of electricity; and many were the devices resorted to with the view of showing the rotation of a conducting wire round a magnet, and that of a magnet round a wire. The writer was by Faraday's side when the two rough arrangements began to work. He can see the face of the experimenter now, as it appeared forty-six years ago, beaming with joy—a joy not unmixed with thankful pride—when the magnet commenced to move round the wire and the wire round the magnet. Well does he remember the exclamation, "There they go! there they go! we have succeeded at last!" After this great discovery Faraday considered that he was entitled to a little recreation, and to please the writer he suggested a visit to Astley's Theatre. There was a crush at the pit entrance, and the conduct of a rough fellow who subjected the writer to some unnecessary squeezing excited Faraday's anger. He ordered the fellow to behave himself, unless he wished to get into trouble, and he appeared quite ready to support his words by thumps.

METALLURGICAL EXPERIMENTS.

In 1822 Faraday conducted a long series of experiments for Mr. Stodart on the alloying of steel with the rarer metals, so as to harden it and render it less oxidisable. Pieces of steel, with small proportions of platinum, rhodium, etc., were fused into buttons, and then worked and tested. The writer had to blow the bellows for many a weary hour, and much caution was requisite at the end of each operation, to avoid the melting of the luted crucible. The heat available was more than enough to melt the best Hessian crucible. On one occasion many scraps of platinum-foil were subjected to the action of the furnace, and partially fused into a nearly perfect button, probably the first button of platinum, obtained by simple fusion, seen.

FARADAY NEARLY BLINDED.

About the end of 1823 Faraday was nearly deprived of his sight. Oxygen had been made in the usual manner from the black oxide of manganese, and as he was in the act of wrenching the delivery-tube out of the iron bottle some water from the trough passed through the tube and fell upon the red-hot manganese in the bottle. The scalding stream burst forth, carrying with it particles of the heated manganese, some of which got into Faraday's eyes. The writer led the sufferer to the sink, and, leaving him with his face in a pail of water, he called Mrs. Greenwood, and despatched the porter for Dr. Paris, who lived in the next street. He then rushed off to Saville Row, the hotbed of medicine. Finding that the first doctor called upon was from home, he hurried to the house of a second, but before he reached it he came to grief himself, by running against a post in the street with such force that he fell down as if shot. Ultimately he found Dr. Kerrison, of Old Burlington Street, at home, and took him, as fast as possible, to Albemarle Street. Other medical men soon arrived, and Faraday was conveyed to his apartments and well cared for. His face was badly burnt, and some days elapsed before his eyes were pronounced to be out of danger. In the laboratory there were masks of wire and thick glass, also goggles for protecting the eyes when dangerous experiments were performed, but these were rarely used.

THE FOUNDER OF THE FULLERIAN PROFESSORSHIP.

In 1833 John Fuller, Esq., M.P., founded a Chair of Chemistry at the Royal Institution, and nominated Faraday the first professor. Mr. Fuller, familiarly called Jack Fuller by his compeers, was remarkable for his good-natured boisterousness, which was so different from the gentle deportment of most of the members of the institution. He was a tall portly man, and one might see from the high colour of his face that he enjoyed the good things of this life. His morning dress consisted of a blue coat with metal buttons, a coloured vest, grey smalls, white stockings, and low shoes. He was a regular visitor at the fashionable lectures, but he attended them rather as a lounger than as a scientific student. However, when the funds of the institution were low, and the expenses were exceeding the income, he promptly and liberally came to the rescue.

FARADAY AND THE ATHENÆUM CLUB.

In 1824 the Athenæum Club was formed for the association of persons of scientific and literary attainments, artists, and noblemen and gentlemen, patrons of science and letters. The first place of meeting was a small house in Waterloo Place. Faraday was its first Honorary Secretary, and the writer occasionally carried the council books from the Royal Institution to the club-house. Faraday recommended his old friend Mr. E. Magrath as Secretary, and this gentleman occupied the post for many years.

OTHER CONNECTIONS.

Faraday was a member of a small scientific society held at a friend's house in a street leading out of Fleet Street, where he lectured at times. He also belonged to a private scientific body, the meetings of which were held at the houses of the members.

DISINFECTION OF THE PENITENTIARY.

In 1824 a bad and fatal fever broke out in the Penitentiary at Milbank. Faraday was applied to, to fumigate that wretched establishment. He resorted to the use of chlorine, and the result was considered successful.

FARADAY AT THIRY-THREE.

We now come to the autumn of 1824, when Faraday had attained a high scientific position. His life and occupations were of the most regular character. He was of a cheerful disposition, and played the flute a little. He regularly attended the Sandemanian chapel on Sundays and Wednesday evenings. He now married a co-religionist, Miss Barnard, the daughter af a silversmith in Paternoster Row, bringing his wife home to the institution.

CORRESPONDENCE.

THE METROPOLITAN WATERS IN JULY.

To the Editor of THE LABORATORY.

SIR,—The appearance of Dr. Frankland's 'Report on the Waters supplied to the Metropolis during the month of July, 1867,'* which virtually contradicts our own analysis of these waters,* obliges us to make a statement.

According to this report the London waters were devoid of "organic nitrogen;" or, adhering strictly to the letter of the report, all the London waters taken on July 1st and July 2nd were so completely free from organic nitrogen as not to contain one part of it in 100 million parts of water. Our own examinations of the majority of these same waters, taken later in July, but, without doubt, in much the same state as at the beginning of the month, showed from three to thirteen parts of organic nitrogen in 100 millions of the different waters.

We have to state that, notwithstanding the acknowledged weight of the authority against us, we maintain the essential correctness of our analysis. Indeed, the proof which we are prepared to offer is so direct and decisive that we should simply trifle with the subject were we to affect any doubt in the matter. If any one will take the trouble to boil a litre of a London water (the West Middlesex, or other water on our list) with a little carbonate of soda until the distillate from it is free from ammonia, and then will distil the residual water with a little potash and permanganate of potash, he will obtain a distillate containing a very appreciable quantity of ammonia, which may be estimated by the Nessler test.

Where does this ammonia come from? Not from the reagents, for if distilled water be substituted for the London water there will be no evolution of ammonia on distillation with alkaline permanganate. Not from nitrates nor nitrites, for they will not give it if put into the distilled water. In short, there is no escape—the ammonia can only arise from nitrogenous organic matter in the London water. Such is the evidence on which we rely for proof that certain waters contain nitrogenous organic matter.

Let us now turn to the evidence on the other side of the question. It is oblique, and involves the performance of chemical operations with a degree of accuracy almost inconceivable. From Frankland's table, above referred to, we learn that the nitrogen of the nitrates and nitrites, together with the nitrogen of the ammonia, was so accurately equal to the total nitrogen in each one of the eight London waters, that there could not be one part of organic nitrogen in 100 million parts of the water. In practice, more than a litre of water is seldom employed. If the table be consulted it will therefore be obvious that, if the figures are trustworthy, the determination of total nitrogen must have been made accurately to $\frac{1}{100}$ of a cubic centimetre, and also that the nitrogen of the nitrates and nitrites must have been estimated to $\frac{1}{100}$ of a milligramme. In point of fact, unless we are prepared to admit accuracy of this very high order, the constantly recurring all-but-identity of the two sets of numbers—sum of the inorganic nitrogen, and total nitrogen—is unintelligible. Such a degree of accuracy we believe to be unattainable in the present state of the science.—Yours very truly,

J. ALFRED WANKLYN.
E. T. CHAPMAN.

London Institution.

* See LAB., Aug 10, p. 342.

* Aug. 3, p. 319.

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CONTENTS.

ORIGINAL COMMUNICATIONS.

MR. BARFF ON OPAQUE SILICIOUS COATINGS.

On some Applications of Soluble Silicates. By F. S. BARFF, *M.A. (Cantab.), F.C.S. Part III. Opaque Silicious Coatings applicable to Stone Preservation and for the Prevention of Damp in Walls.*

BEFORE a Parliamentary Committee, held some five or six years ago, to inquire into the causes of decay in the stone of the Houses of Parliament, and into existing methods for stone-preservation, I gave evidence on a process which involved the use of a soluble silicate with an insoluble reagent. An objection brought against it was that the substance formed, being opaque, would cover up and hide the surface of the stone, and that, being superficial and not penetrating at all, it would be liable to be chipped or rubbed off, and so parts would be exposed to the weather, even if it answered, where it remained perfect. The alteration of the appearance of the building-material, if it be a good one, is to a certain extent a valid objection to the employment of any indurating process, although Sir C. Barry did not object to a rather unsightly one being used on the Speaker's Court. It is, however, surely better to have, if only in parts, a coating applied which will arrest decay—if not altogether, at least for a considerable time—than to allow it to proceed unchecked; and there are instances in which an opaque coating can be used for stone preservation, and if carefully applied, with but little injury to the effect of the building. The transparent process has been already described in the third article on soluble silicates.

I now purpose to explain the opaque method, and what I conceive to be its useful and successful applications. When stone is much decayed, as has been already shown, the silicate of alumina and potash alone does not prevent further decay for any length of time; but if the disintegrated portion of the stone be carefully removed, and the opaque coating be applied to those parts, the absorption of damp will be prevented and the surface will be protected from the action of other destructive influences. The sound stone in the same building can be treated with silicate of alumina and potash; and so the whole can be indurated. It may be here objected that two different effects will be produced in the appearance of the stone, but this objection is by no means insuperable; colour can be used with the solid substance employed, so that it can be made to correspond very nearly with the other parts; and as in old stone buildings a variety of tints are observable, and where decay has taken place to any extent considerable irregularity of surface also, the effects produced by the different protecting materials will not be noticed, for the object in indurating an old building is not to make it look new, but rather leaving it as it is, to protect it from further destruction. The process which I explained to the committee consists in using silicate of potash with some such substance as carbonate of lead or zinc. The latter carbonate is preferable, as it does not form a black sulphide, and therefore retains its colour. When a soluble silicate is mixed with white lead, the mixture sets very hard in a few minutes; the action is similar to that of plaster-of-paris mixed with water, though it is more energetic. A chemical union takes place, the greater part of the potash remaining combined if the silicate be nearly neutral. I shall have occasion again to refer to this combination in employing other useful applications of soluble silicates. As a coating for walls, very considerable difficulty attends its use. White lead cannot be mixed with the silicate, from the rapidity with which it becomes solid; and although I have tried many methods to retard this action, I have not succeeded. The same difficulty occurs when zinc carbonate is used, though not to the same extent. When, therefore, it is thought necessary to employ the zinc salt as a coating, it must be applied as in the way recommended in silicious painting—that is, it must be laid on with water, and when dry be wetted with silicate syringed on, as in stereochromic painting. But a far more easy and in most cases, though not in all, better way is to moisten the decayed stone, after cleaning off all decayed matter, with dilute silicate of alumina and potash, and then to apply carbonate of lime, mixed with the same material, with an ordinary painting brush, stippling it, so as to give it the appearance of the granulated surface of the stone; when dry, it will adhere sufficiently to allow of other washes of silicate of alumina and potash being brushed on.

But by far the most useful and important application of opaque silicious coatings is for the exclusion of damp, and here I have found them in all cases successful where the ground has been such that adhesion between it and the coating could take place. Two methods equally good have been tried with perfect success, on a large scale, in most exposed situations, and under unfavourable circumstances. The presence of damp in walls arises from three causes—either from the porous condition of the materials of which they are built allowing the penetration of damp from without; from

the existence of salts in the mortar, bricks, or stone, which absorb and give out moisture according to the changes of the weather; or from damp foundations. The first *only* can be remedied by the application of external coatings, the second by battening the walls, and the last by removing the adjacent earth from the foundations.

Patented and secret processes depending on the use of soluble silicates have been, and still are, advertised, which profess to cure damp walls, from whatever cause the damp may arise. I have found silicious coatings only useful for keeping wet from entering from without; and it does not seem possible by such processes to arrest it if it arises from other causes.

My first process, which consists in the use of silicate of alumina and potash with carbonate of lime, was some years ago applied to two large houses situated on the shores of Dublin Bay, within a hundred yards of high-water mark. These houses are exposed to the east and north-east winds, which prevail on the east coast of Ireland during the early part of the year, causing the rain and sea-spray to beat violently against them. In addition to this, the climate is much more humid than our own. Under these influences the walls, which were built of rubble-work covered with coarse stucco, let in the water soon after their completion, and it was found impossible to retain the paper on the walls of those rooms which fronted towards the sea. The question was what could be done to remedy this annoyance and render the walls proof against damp. The gentleman who built the houses, having had practical experience in building, dreaded the use of oil-paint, as being an expensive and temporary remedy. He at last decided to try the solid silicious paint, and its effect has been to keep out the damp entirely, so that the paper remains on the walls, and no change whatever has taken place in the external appearance of the houses, although they have been coated for nearly six years.

The second process which I shall describe was used on a house at Claydon, in Buckinghamshire. This house was built of porous red brick, through which the water penetrated so freely that it often ran down the angles of the rooms. Since the application of the silicate, about five years ago, it has been entirely free from damp.

I mention these two instances as I know how incredulous persons are when they hear of any new invention, especially if they think that its advocate has an interest in its success, which is not so in the present case, my object being simply to make public what will, I believe, be of use to those who are suffering from the annoyance of damp water, and who have doubtless tried many expedients and spent much money in vain attempts to remedy an evil which so often occurs in these days of cheap and bad building. I have also written these articles, as I have before stated, in the hope that they may induce chemists to give more attention to the applications of soluble silicates, which appear to be very extensive, and that they may bring to bear on the subject a far greater amount of scientific knowledge than I have been able to do.

Silicate of alumina and potash, when mixed with carbonate of lime, does not set rapidly, but gives ample time for working with it; in this respect it is much more manageable than silicate of potash and carbonate of lead. The two substances may be mixed for a whole day without solidification taking place; but when they are applied to a wall, they soon dry and exhibit considerable hardness; but inasmuch as a portion of the liquid passes into the walls of the building, after-coats must be put on to supply its place. In most cases two are sufficient, but where the walls are very absorbent and the surface rough a third coat is often necessary. The point which requires particular attention is, that the wall surface should be completely covered with the solid coat, and to effect this on rough stucco surfaces two coats of the solid paint are sometimes requisite over the whole wall, but often only over parts of it. It is found best to use the second coat thinner than the first, and to stipple it so as to force it into any cracks which may have been left by the drying and contraction of the first. When these solid coats are perfectly dry, dilute washes of the silicate of alumina and potash may then be applied with a brush, and they should be repeated till, on drying, they leave a slightly glossy surface, which gloss in a very short time will entirely disappear, and the whole, if properly tinted, will have an appearance very similar to natural stone. It has often been asserted that stone or cement can be rendered absolutely impervious to wet by the application of silicious coatings; this, as far as I know, is not correct; it is one of those sweeping assertions which, having been proved untrue, have rendered persons altogether suspicious concerning the efficacy of silicates for such purposes. A series of experiments was made to try, as far as possible, to render a porous stone proof against the passage of water through its substance. Pieces of Caen stone, about six inches square and three inches thick, were hollowed out in the form of bowls, the thickness of stone left being about three quarters of an inch at the bottom of the bowl; one of these was carefully saturated with silicate of alumina and potash, and the inside

of the bowl was also protected by the solid coating. The bowl was filled with water, and after a time it slowly filtered through and the stone became moist at the bottom. Similar trials we made with other compounds, and it was interesting to notice the different results when a bowl was treated with only silicate of potash; after sufficient time had been allowed for it to dry, it was filled with water, which soon began to percolate through it; the water, when examined, was found to be strongly impregnated with silicate of potash, and after a time nearly the whole was washed out of the stone. Another, treated with silicate of potash and chloride of calcium, gave better results, although it did not offer nearly so much resistance to the passage of the water as did that which was saturated with silicate of alumina and potash. Moreover, a large quantity of chloride of potassium was found in the water which passed through it, as well as some silica. But in the experiment where silicate of alumina and potash were used, although water did pass through after a long time, but little potash was found in it, thereby proving that nearly the whole had entered into insoluble combination with the silica and alumina.

The fact that it is not possible at present to render stone or other similar substances perfectly water-proof by any of the processes described may seem to militate against their success as preventives to the penetration of damp in walls. It must, however, be remembered that the conditions are so very different. The bowls were exposed to the continued action of the water for a long time, and subject to its vertical pressure; whereas the rain, however heavy, which falls on a house, strikes it in a slanting direction, and runs off altogether if the surface of its walls is sufficiently impervious to throw off that which first falls on it. I have noticed this fact and mentioned these experiments because it is natural to persons desirous of trying any process suggested to them to put it to the most extreme tests, and to discard it at once as worthless if it does not answer to them.

There is no necessity whatever to make a wall absolutely waterproof in order to enable it to throw off the largest quantities of rain which can ever fall upon it. That the method which I have just described is perfectly effectual for the exclusion of very large quantities of rain and sea-spray drifted by strong winds is proved by the fact that the houses which were coated with it on the shores of Dublin Bay have for nearly six years stood the severest test to which it could be well put, and that without any injury whatever to its durability.

The other process to which I have alluded, as having effected the same object in a house at Claydon, in Buckinghamshire, consists in the employment of sulphate of baryta and carbonate of lime mixed with silicate of potash. Of the two this is the less expensive process, and is perhaps more easy of application; but I have greater faith in the durability of the other, although, up to the present time, both seem to have answered equally well. The reason, in my opinion, is that less potash is left free in the former case, and the compound formed has resisted more severe laboratory tests than the latter. Sulphate of baryta and carbonate of lime should be mixed with water in equal parts and allowed to settle; the water should be poured off, and the solid residue mixed with silicate of potash; the mixture should be well stirred, otherwise the heavy sulphate of baryta will sink to the bottom. Colouring matter, formed of colours recommended for silicious painting, can be used to bring the paint to the required tint. In no case must Venetian red be employed. The method of application is just the same as with the silicate of alumina and potash and lime. The wall must be perfectly covered, and when dry other washes of dilute silicate of potash must be put on till the surface dries with an egg-shell gloss.

Some trials have been made with the baryta compound, which have not answered well, but this has been owing to the bad state of the ground. The conditions necessary for success are, first, that the wall should be coated with a porous material, such as lime or Portland cement; and, secondly, that the coating should be sound. A wall which has been once painted is altogether unfit for any application of silicious washes, for the reason that it is not absorbent, and this is the case with surfaces which have been painted for many years, even after all appearance of paint has gone; the oil which has penetrated below the surface will prevent suction; if, therefore, in such a case, it is wished to use either of my processes, the whole cement or stucco must be removed and a fresh coating be put on. The best ground for any silicious work is lime and sand. It has also other advantages—it is cheaper than cement, it admits of a different finish, and is considered by authorities in such matters to be a more legitimate material. In new buildings it would be better to use lime and sand at once, and then to cover it with lime and silicate of alumina and potash; the expense of the whole would not be greater than that of Portland cement, and the advantages gained would be dry walls, a stonelike surface, to which dust would not adhere, which might be washed with ease, and which would not involve a triennial expenditure in oil paint. Although I recom-

mend lime stucco for new buildings, I do not wish to imply that Portland cement surfaces cannot be effectually treated. I have seen the baryta process applied to them with perfect success. It seems strange that year after year persons should go on painting their residences with a material like white lead, which every one knows changes colour from the action of sulphuretted hydrogen, and that those who manifest refined taste in the interior arrangements and decorations of their houses should be content to have the exterior covered with shining paint, a material the very perishable nature of which marks it as unfit for such applications. If the cement-fronted buildings in our squares and streets were coated with silicious paint, they would, at least, look somewhat like stone, which they are intended to represent, and it would render more complete the illusion which oil paint altogether destroys.

PROF. WANKLYN ON WATER ANALYSIS.

Reply to Mr. Dugald Campbell's Note on Wanklyn, Chapman, and Smith's Method of Determining Nitrogenous Matters in Water. By J. ALFRED WANKLYN.

ACCORDING to Mr. Campbell, weak aqueous solutions of white of egg are sensibly decomposed when they are boiled with carbonate of soda, in the manner employed by my colleagues and myself in our process of water analysis.

Mr. Campbell's experiment was made upon a litre of water, into which he had put white of egg containing nitrogen equivalent to 0·11 milligrm.* of ammonia. He added 2 grm. of carbonate of soda, and distilled rapidly, and obtained 0·04 milligrm. of ammonia in the first 200 c. c. of distillate.

Mr. Campbell repeated this experiment and arrived at a similar result. He then took still more dilute solutions of albumen, and ultimately got the whole of the nitrogen of the albumen in the state of ammonia in the first 300 c. c. of distillate. So much for Mr. Campbell's result with white of egg.

The following experiments have been made by me since the close of the meeting of the British Association with the object of testing the correctness of Mr. Campbell's statement.

I. One and a half litres of spring water were distilled from a little alkaline permanganate, and the resulting 1300 c. c. of distillate placed in a retort and boiled until 300 c. c. had come off, thus leaving 1000 c. c. of ammonia-free water. Next, 3·2 grm. of anhydrous carbonate of soda and 0·2456 grm. of fresh white of egg were dissolved in 100 c. c. of distilled water (containing 0·01 milligrm. of ammonia). This 100 c. c. of solution was then put into the retort to the 1000 c. c. of ammonia-free water. On distilling, the contents of the retort frothed very unpleasantly. The distillate was as follows:

1st.	100 c. c. = 0·03 milligrm. of NH_3.		
2nd.	100 c. c. = 0·03	"	"
3rd.	100 c. c. = 0·02	"	"
	0·08		

From this I deduct 0·01, equal to the ammonia in the 100 c. c. of water, in which I had dissolved the carbonate of soda and albumen, and get 0·07 milligrm. as the amount of NH_3 yielded by the 0·2456 grm. of white of egg. The total nitrogen in the 0·2456 grm. of white of egg corresponds to about 5·0 milligrm. of NH_3. Therefore 100 parts of *albuminoid* ammonia have lost about 1·4 in the treatment with carbonate of soda.

On subsequently adding alkaline permanganate to the residue in the retort and distilling, abundance of ammonia was evolved.

II. A litre of spring water was put into a retort and distilled until a little more than 100 c. c. had come over. Next, 2 grm. of carbonate of soda and 20 milligrm. of fresh white of egg were dissolved in 100 c. c. of distilled water (containing 0·01 milligrm. of NH_3), and the solution added to the water in the retort and the whole distilled.

1st distillate,	100 c. c. = 0·015 milligrm. NH_3.		
2nd "	100 c. c. = 0·005	"	"
3rd "	100 c. c. = 0·000	"	"
	0·020		

From this I deduct 0·01, equal to the NH_3 in the 100 c. c. of distilled water, used to dissolve the carbonate of soda and albumen. Therefore, 0·01 milligrm. is the amount of ammonia evolved by the action of the carbonate of soda.

Potash and permanganate of potash were then added to the residue in the retort, and the distillation continued; 0·46 milligrm. of NH_3 were obtained.

The result of this experiment is, therefore, that 100 parts of albuminoid ammonia lost about 2 parts on being treated with carbonate of soda.

III. A litre of spring water, 1·864 grm. of carbonate of soda, and 3·5 milligrm. of fresh white of egg (weighed on a bit of platinum foil) were introduced into a retort and distilled:

1st distillate,	100 c. c. = 0·000 milligrm. NH_3.		
2nd "	100 c. c. = 0·000	"	"
3rd "	100 c. c. = 0·000	"	"
	0·000		

On subsequent distillation with permanganate, 0·105 milligrm. of NH_3 were obtained. The water used in this and the second experiment was examined repeatedly: results, one litre contains 0·00 milligrm. free ammonia, and from 0·075 milligrm. to 0·063 albuminoid ammonia. It will be observed that in experiment III, the full amount of ammonia was not obtained, 0·14 milligrm. is calculated, and 0·105 was obtained. Probably the treatment with permanganate was incomplete, for no precautions were taken to insure complete action. Moreover, to weigh out

* I translate Mr. Campbell's grains into grammes and milligrammes.

3·5 milligrm. of liquid white of egg on a bit of platinum foil is not an operation having any claims to precision. All that was aimed at in the permanganate treatment in experiment III was to show, unequivocally, that there had been an appreciable addition of albuminoid matter to the water.

I have thus taken 5·00, 0·40, and about 0·04 milligrm. of *albuminoid* ammonia in the shape of white of egg, and in no case got over 2½ per cent. of the albuminoid ammonia evolved by carbonate of soda.

The many instances in which my colleagues, Chapman and Smith, and I have got almost a zero for *free ammonia*, and a considerable number for *albuminoid ammonia* in a natural water, exemplify the stability of albumen in presence of a boiling solution of carbonate of soda of the strength used by us to drive off free ammonia and break up traces of urea. I have no hesitation in pronouncing the result arrived at by Mr. Campbell to be an error, and in saying that Mr. Campbell's ammonia did not arise from the action of the carbonate of soda on the white of egg. Perhaps it was in his distilled water; perhaps his distilled water contained something capable of acting on minute quantities of albumen—but however this may be, I deny his conclusion in the most absolute manner.

With regard to the determination of urea by our method, Mr. Campbell admits that the first 300 c.c. of distillate will contain all the ammonia from the urea when it does not yield more than 0·10 milligramme per litre. As Mr. Campbell will see, on consulting our paper in the September number of the 'Chem. Soc. Journal,' we maintain that evolution of ammonium from urea on boiling it with our solution of carbonate of soda is gradual. In fact, as Mr. Campbell will learn, when he does us the favour of reading our paper, we make the continuity of the evolution of ammonia a criterion to distinguish between urea and ammonia or ammoniacal salts.

Mr. Campbell's result that the evolution of ammonia from urea is discontinuous is unintelligible to me. In conclusion, I have to state that no circumstance which has yet come to my knowledge leads me to modify anything given in our paper on water analysis, read to the Chemical Society in June.

CORRESPONDENCE.

SCIENCE IN SCHOOLS.

To the Editor of THE LABORATORY.

SIR,—I have read with interest and cheerfully endorse the statements you have recently advanced with respect to the teaching of experimental science in our public schools. I agree with you also in the opinion that "there has not been sufficient laboratory work," undertaken for the purpose of giving a practical tendency to such studies. But this deficiency is, I can assure you, in a great measure counteracted by the private enterprise of the more advanced pupils, who generally manage to find opportunities of repeating the experiments they have seen performed at the lectures, and in many instances proceed further in the way of constructing apparatus for themselves at home. I have seen many good electrical machines, voltaic batteries, and pieces of physical apparatus, not only made under these circumstances, but afterwards put to good uses in eliciting a practical acquaintance with the leading facts in several branches of experimental science, particularly of heat and electricity. I would refer especially to what has come under my own observation in the City of London School, and I can point to results in support of my assertion, that much progress has been, and is now being, made in the heart of the great metropolis itself. For twenty years past the lecturer in science—himself a graduate of the London University, and formerly student in the Royal College of Chemistry—has been making praiseworthy efforts to extend the benefits arising out of the study of Natural Science, and by dint of constant perseverance has been mainly instrumental in the establishment of one of the first Science-scholarships. To him belongs the credit of originally directing the scientific studies of the discoverer of mauve, and those of a score or more past pupils of the school besides, who are enrolled Fellows of the Chemical Society. Many have adopted a scientific profession in consequence of such early training, myself among the number, and it behoves us now to see that no injustice is done by omitting mention of the results in the City of London, whilst Eton, Harrow, Clifton, Cheltenham, and others, receive the creditable notice to which they are all fairly entitled.

For seven years past the study of chemistry and the allied sciences has been introduced as a branch of general education in the City of London School, and prizes offered in *all* the classes, by way of encouragement, besides a silver medal given annually by Mr. Alderman Hale. The lecture course is necessarily somewhat elementary, and there are not at present any facilities offered for laboratory practice, mainly on account of the want of space; but surely the circumstance, that upwards of six hundred youths have the opportunity of attending Mr. Hall's lectures, and of seeing the prominent facts of science experimentally demonstrated, must be a hopeful sign for the future; and I know, from my own experience as examiner, that the information thus acquired in the school is, in the case of the senior pupils, largely supplemented, both by reading and private study, with such aids as they are enabled to command at home during the necessarily short intervals of leisure.

The importance of the subject, and a wish to see justice done in all quarters, must be my apology for the length of this letter.

I am, Sir, yours respectfully,

JOHN SPILLER.

Woolwich, Sept. 23, 1867.

[We thank Mr. Spiller for reminding us of the admirable results of the chemical teaching in the City of London School. We ourselves have had opportunities of testing the knowledge possessed by some of Mr. Hall's pupils, and we are glad that our correspondent has awarded the well-deserved praise which we inadvertently withheld.—ED. LAB.]

PARIS UNIVERSAL EXHIBITION.

SPAIN, ETC.

BY C. W. QUIN, F.C.S.,
Superintendent of the Chemical Classes of the International Exhibition of 1862.

Spanish minerals—Rock crystal from Japan—South American minerals—Conclusion.

PARIS; *September* 24.

THE catalogue of Spanish minerals is still unpublished; we must, therefore, content ourselves with pointing out a few of the prominent products. The collection, which is a very fine one, is displayed in a special annex a little to the right of the gate leading to the *école militaire.*

Flanking the entrance we have a noble specimen of coal from Belmez (Cordova), and there are several exhibitors of this valuable mineral from Barcelona, Cuença, Leon, Lerida, Ovieda, and other localities. In fact, Spain seems not only teeming with metalliferous deposits in great variety but she also has at her command sufficient coal and lignite to enable her to work her mines for her own benefit instead of that of other nations. In iron ores, too, she appears to be tolerably rich. We have red and brown hematites, spathose ore, and a few specimens of magnetic ore from the districts of the Asturias, Cordova, Bilboa, Gerona, Leon, and Santanda, all apparently of excellent quality. The cinnabar from Almadin shown by the State is undoubtedly the finest ever seen; it lies about the building in massive blocks of immense size, all apparently singularly free from vein stuff. These mines, we are informed, contain veins which measure from 25 to 30 feet in thickness, and the deposit appears to be practically inexhaustible. It is said that these precious deposits are mortgaged to the house of Rothschild. The show of argentiferous galena from Murcia, Caceres, Ciudad Real, Jaen, and several others is very fine. The Rio Tente Company show a large number of specimens from the famous copper mines of the district, and the Province of Huelva exhibits a series of very beautiful pyrolusites and other manganese ores. Calamine and blende are well shown by several proprietors of mines in the Asturias and Santanda, and tin is represented by good samples from the famous Nuestra Senora del Val mines in Orense. The Academy of Sciences of Madrid show fine specimens of crystallised native sulphur and hair salt from the Corril mines and a meteorite which fell in Murcia in 1858.

The show of chemicals in Spain is exceedingly bad, both as to quality and quantity.

Amongst the medley of articles shown by Japan there is a splendid collection of rock crystal from the province of Kei. Some of the specimens are of great size and all are of extraordinary transparency.

The collections of silver and copper ores in the courts devoted to the South American republics will repay a close examination. From Chili we have some magnificent specimens of silicate and green carbonate of copper, galena, and iron ore, a splendid meteorite, and a fine series of argentiferous ores, including several beautiful specimens of ruby silver. Peru, curiously enough, sends nothing to Class 40 but a few specimens of baracite, and coca leaves to Class 44.

We have now come to the end of our task of guiding our readers through the finest display of mineral and chemical products ever brought together under one roof. To ourselves, at least, the journey has been a most pleasant one, for at every turn we have met with some new beauty of nature, some fresh discovery of science. The labour of examining in detail the countless treasures displayed in the *Champ de Mars* has been a heavy one but it has been lightened in no small degree by the painstaking kindness of every one with whom we have come into contact, from the philosophers whose names are known wherever the universal language of science is spoken down to the humblest attendants in charge of the various collections we have described. To the members of the Commissions of nearly every nation we have been indebted for much information of a unique and valuable kind which they have one and all placed at our disposal. The pleasure we have derived during our work has in only too many instances been alloyed by finding exhibitors displaying their products in such a manner as to render them perfectly useless as representations of the particular industry they should have illustrated. Carelessness and untidiness have shown themselves at almost every step, and the art of exhibiting appears to have sadly retrograded during the last five years. It is hardly within our province to seek for remedy for this evil, but from our experience of the Exhibitions of 1851, 1855, and 1862, we are compelled to assert that it is on the increase. We have already spoken somewhat severely of the short-comings of our own countrymen in this respect, but we find, on a closer view of the displays of other nations, that they are just as culpable. Another matter for sad reflection is the poor show made in some departments of mineral and chemical products by our own great mine-owners and manufacturers. Many have come forward to show that Great Britain is still at the head of all nations in certain branches of production and manufacture, and that she is ready and willing to hold her own against all comers; but in others, although she still keeps her place in the markets of the world, she has neglected, or possibly disdained, to show the smallest specimen.

After six months' pleasant companionship it is hard to part company, but in doing so let us hope that we have been successful, not only in acting as guide to those whose good fortunes have allowed them to witness the splendid display in the *Champ de Mars*, but also in conveying, however faintly, some notion of all these wonders and beauties to those whom circumstances have prevented from enjoying them to the full.

Of the good results to humanity of the present Exhibition it is for others to speak. M. Leplay, once a faithful votary of science, and his fellow-hucksters, have tried their best to stamp out the grand idea of International Exhibitions by turning

the present one into a means of fleecing the inhabitants of all nations. They have bartered light, air, and space, for money; they have given concessions at ruinous prices for the right to sell every conceivable article of trade, from indecent books, sweetmeats, and penny trumpets, upwards; they have filled the building with dwarfs, giants, quacks, and mountebanks; and, finally, by their petty tricks, insolence, and illiberality, they have made enemies of the true masters of the world—the foremost philosophers and writers of all countries. But, in spite of all this ill treatment, the grand idea of universal exhibitions will still triumph over all the machinations of the arch-traders of the world, for every succeeding lustre proves incontestably that now-a-days, as well as in the olden time, there exists in every nation of the earth an ever-increasing band of thinkers and workers, who, without thought of reward, labour unceasingly and effectively for the greater glory of God, and for the improvement, both moral and physical, of their fellow-man.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B. CHEMICAL SCIENCE.

On a New Manufacturing Process for the Perpetual Regeneration of Oxide of Manganese used for the liberation of Chlorine from Hydrochloric Acid. By WALTER WELDON.*

EVERY process, previous to that to be described in the present paper, by which it has been attempted to regenerate oxide of manganese from the residues of the manufacture of chlorine, has been performed in the dry way, and has thus required considerable time, and has involved not only at least one—more or less troublesome and costly—furnace operation, but also several removals of the material from vessel to vessel and from place to place; every such removal, of course, entailing more or less loss of material. The process, however, which is about to be described is performed in the wet way, and may be completed, even when operating on the largest scale, within as little as one hour. Moreover, all the operations of the process are performed in the same vessel as that in which the oxide produced by it is afterwards employed to react with hydrochloric acid, and from this vessel or still the manganese is never removed, so that it is entirely free from risk of loss by removal; and as it is not subject to any other cause of loss, a charge of manganese, once put into a still, when treated by this process, not only never needs to be replaced, but never needs even to be added to, while it will liberate an equivalent of chlorine every few hours for literally any length of time. The starting-point of any process for the regeneration of the oxide of manganese employed in the manufacture of chlorine, must, of course, be that residue which is known as "still-liquor," being that which remains in the stills when oxide of manganese and hydrochloric acid have been digested together until all the chlorine which the oxide is capable of liberating from the acid has been liberated and given off. When working with a native oxide of manganese, the still-liquor contains, in addition to a quantity of protochloride of manganese equivalent to the quantity of oxide of manganese which has been dissolved, a considerable quantity of free acid, and more or less chlorides of iron and other bases, due to the native oxide of manganese being always more or less associated with other oxides. When working, however, with the artificial oxide of manganese produced as is about to be described, the still-liquor contains scarcely anything whatever but protochloride of manganese; and the new process consists simply in first adding an equivalent of lime to this liquor, without removing the liquor from the still, and then blowing atmospheric air through the resulting mixture of protoxide of manganese and solution of chloride of calcium. The white protoxide is thereby rapidly converted into a very dark-coloured higher oxide, and when this product has been allowed to subside from the solution of chloride of calcium in which it was formed, and the greater part of that solution has then been drawn off from it, it is ready to be treated with hydrochloric acid, from which it then liberates chlorine, with reproduction of exactly as much protochloride of manganese as was commenced with. From this point the very simple series of operations described is repeated just as before, and so on, over and over again, for any required number of times. The manganese is thus constantly undergoing, always in one and the same vessel, a round of regularly recurring changes of state of combination, by which it passes, first from the state of protochloride to that of protoxide, next from the state of protoxide to that of a higher oxide, capable of liberating chlorine from hydrochloric acid, then back again to the state of protochloride, and so on continually. As regards the richness of the oxide produced by the process above described, sesquioxide is all that one would have expected to obtain by means of it, but it actually yields a richer product than sesquioxide. Sesquioxide of manganese is, practically—at least from a chlorine manufacturer's point of view—a mixture or compound of about 55·5 per cent. (being one equivalent) of binoxide with about 44·5 per cent. (being also one equivalent) of protoxide; while the oxide most frequently obtained by the process above described contains about 65 per cent. of binoxide, which is about the proportion of binoxide that would be contained in a mixture or compound of three equivalents of binoxide with two equivalents of protoxide. The richest native oxides of manganese which chlorine manufacturers have been in the habit of using contain about 70 per cent. of binoxide; but a native oxide is practically much less valuable, so far as the manufacture of chlorine is concerned, than an artificial oxide containing considerably less oxygen. The reason is that in order to dissolve a hard, compact, anhydrous native oxide of manganese, it has to be digested with a large excess of acid, resulting in the production of a still-liquor containing a very large quantity of free acid, all of which is

* Communicated by the Author.

practically lost; whereas a recently formed, artificial, hydrated oxide, in an exceedingly minute state of division, will dissolve in a bare equivalent of acid, producing a still-liquor containing no free acid at all. Hence, whereas when using a 70 per cent. native oxide it is rarely found possible to obtain in the free state more than one sixth of the chlorine contained in the hydrochloric acid put into the stills, an artificial oxide of less even than sixty per cent. will liberate fully one third of the chlorine contained in the acid put into the stills, and this in far less time, and at a much less cost for labour and fuel, than the native oxide requires for the liberation of half the quantity. The process which I have had the honour to bring before the section, thus, not only substitutes the cost of about seven shillings' worth of lime and three shillings' worth of blowing for every six or seven pounds which the manufacturer of bleaching-powder and other chlorine products has hitherto had to spend upon peroxide of manganese, but also enables him to nearly double his production of those products from a given quantity of hydrochloric acid.

On the Formation of Succinic Acid from Chloride of Ethylidene. By MAXWELL SIMPSON, M.D., F.R.S.*

Some years ago† I ascertained that when bromide of ethylene is successively treated with cyanide of potassium and caustic potash ordinary succinic acid is formed. This reaction has since been confirmed by M. Geuther‡, who, however, employed chloride instead of bromide of ethylene.

It occurred to me that it would be interesting to ascertain whether the chloride of ethylidene would, when subjected to the same treatment, produce the same or an isomeric acid. One would naturally be inclined to expect the latter result, seeing that the constitution of the chloride of ethylidene is different from that of the chloride of ethylene. The following formulæ will make this intelligible, and show the probable constitution of the isomeric acid:—

$$\begin{array}{ccc} CH_2Cl & CH_2Cy & CH_2(COOH)' \\ | & | & | \\ CH_2Cl & CH_2Cy & CH_2(COOH)' \\ \text{Chloride of ethylene.} & \text{Cyanide ethylene.} & \text{Ordinary succinic acid.} \end{array}$$

$$\begin{array}{ccc} CH_3 & CH_3 & CH_3 \\ | & | & | \\ CHCl_2 & CHCy_2 & CH(COOH)_2 \\ \text{Chloride of Ethylidene.} & \text{Cyanide of Ethylidene.} & \text{Isomeric acid.} \end{array}$$

It is to be observed that, in the transformation of cyanide of ethylene into ordinary succinic acid, the group COOH takes the place of each equivalent of cyanogen. In the transformation of cyanide of ethylidene, it is to be supposed that the cyanogen is replaced in a similar manner, an isomeric acid being formed.

In order to determine this point I made the following experiments:—

A mixture of one equivalent of pure chloride of ethyle chloré, which is identical with the chloride of ethylidene, two equivalents of pure cyanide of potassium, and a large quantity of alcohol was exposed in a sealed mattrass for 27 hours to a temperature ranging between 160° and 180° Cent. I had previously ascertained that a high temperature was necessary in order to determine the reaction. At the expiration of this time the mattrass was opened and its contents filtered. The filtered liquor was then treated with solid potash and afterwards exposed to the temperature of a water-bath till ammonia ceased to be evolved. When this was observed the alcohol was distilled off, and nitric acid added in excess to the residue. Finally this was evaporated to dryness at a low temperature, and the liberated organic acid taken up by alcohol. By dissolving in absolute alcohol and crystallising from water, it was obtained quite pure. The quantity I obtained was small; dried at 100° Cent., it gave the following numbers on analysis:—

	Theory. Succinic acid.		Experiment.
		per cent.	
C_4	48	40·67	40·86
H_6	6	5·10	5·55
O_4	64	54·23	
	118	100·00	

It had, therefore, the composition of succinic acid. That it was the ordinary acid was sufficiently proved by the following properties and reactions:—It melted at 179° Cent. and sublimed in the form of needles on the application of a higher temperature. The vapour produced, on being inhaled, instant coughing and a painful sensation in the nostrils. The neutralised acid gave an abundant brown precipitate on the addition of perchloride of iron. This test was tried both before and after the body in question had been treated with nitric acid and with the same result.

The only explanation I can give of the formation of ordinary succinic acid in this case is, that the chloride of ethyle chloré was, in presence of the cyanide of potassium, partially converted by the high temperature to which it had been subjected, into chloride of ethylene, one equivalent of hydrogen changing its place with one equivalent of chlorine—

$$\begin{array}{c} CHHH \\ | \\ CHCl_2 \end{array} = \begin{array}{c} CH_2Cl \\ | \\ CH_2Cl. \end{array}$$

Since the above was written, I perceive that M. Wichelhaus* has formed the isomeric acid from cyanpropionic acid. The difference between it and the ordinary acid is well marked. Its melting-point is 40° lower, and it does *not*, when neutralised, give a precipitate with perchloride of iron. These results correspond with the researches of M. Caventon, who has shown that ordinary glycol can be obtained from the bromide of ethyle bromé.

* Communicated by the Author.
† 'Philosophical Transactions' for 1861.
‡ 'Annalen der Chemie und Pharmacie,' cxx, p. 268.

* 'Zeitschrift für Chemie,' Neue Folge, iii Band, s. 247.

On a Compound formed by the Direct Union of Aldehyde and Anhydrous Prussic Acid. By MAXWELL SIMPSON, *M.D., F.R.S., and* A. GAUTIER, *M.D.**

THE synthesis of alanin from aldehydate of ammonia, prussic and hydrochloric acids, and the formation of lactic acid by the action of the same acids upon aldehyde in presence of water, render it highly probable that an intermediate body exists, resulting from the direct combination of hydrocyanic acid and aldehyde. It is this body which forms the subject of the present memoir.

If one molecule of anhydrous prussic acid is added to one molecule of dry aldehyde, contained in a matrass surrounded with a freezing mixture, the two liquids mix without combining chemically, and their chemical combination is not accelerated by heating at 100° Cent. If, however, we leave them in contact for ten or twelve days, at the ordinary temperature of the air, they gradually unite, forming a perfectly transparent and colourless liquid. On subjecting this to distillation it was observed that hardly a drop passed over under 100°, although we operated upon a large quantity of liquid (34 grms.), a small quantity between 160° and 174°, and the remainder of the liquid between 174° and 185° Cent. On redistilling the latter portion, in order to fractionate it, it was found that the greater part passed over at about 183° Cent. Notable quantities of the liquid, however, came over between 40° and 60° Cent., consisting principally of the parent bodies which had been dissociated by the simple vaporisation of the liquid. On leaving these bodies thus dissociated once more in contact for some days the point of ebullition rose, as before, to 183° Cent. The fractions boiling at 180°, and between 183° and 184° Cent. gave, on analysis, the following results:

	Product boiling at 180° Cent.	Product boiling between 183°-184°.	Theory. CNH,C_2H_4O.
C	49·78	51·70	50·71
H	7·44	7·64	7·04
N	20·42	„	19·83

These analyses prove that the body in question results from the direct combination of one molecule of aldehyde and one molecule of anhydrous prussic acid, or at least of equal numbers of molecules of these bodies, and that its point of ebullition is intermediate between 180° and 184°. We have tried the above experiments on mixtures containing the two generating bodies in various proportions, but always with the production of the same body. The name we propose for this compound is cyanhydrate of aldehyde, which is simply founded upon its synthetical formation.

Properties.—The cyanhydrate of aldehyde is a colourless liquid, having a faint odour of its generators; it has a bitter and acrid taste; it does not crystallise at — 21° Cent., but becomes syrupy. It can bear the temperature of 150° for a considerable time without suffering decomposition; at 180, however, slight dissociation commences, and the liquid must be rapidly distilled in order to avoid the loss of a considerable quantity. It is soluble in all proportions in water and alcohol. It may be heated with water in a sealed tube to 150° Cent. without suffering the slightest decomposition, and the entire liquid can be recovered by distillation. Caustic potash appears to separate it into its two generators, forming cyanide of potassium and resin of aldehyde. A little ammonia is also evolved, owing, probably, to the decomposition of the cyanide of potassium.

Gaseous ammonia is absorbed by this body, with the production of a base, which gives a precipitate with bichloride of platinum. Our analyses of this salt have not yet enabled us to ascertain the composition of the base.

A strong solution of hydrochloric acid acts with great violence at the ordinary temperature of the air upon cyanhydrate of aldehyde. If, however, the cyanhydrate is introduced into a balloon surrounded with a freezing mixture, and the hydrochloric acid added gradually, the two liquids mix without any reaction taking place. On removing the open balloon from the freezing mixture, and placing it in water at the ordinary temperature, the reaction soon commences, and proceeds gradually till the entire liquid becomes a mass of crystals. These were twice treated with absolute alcohol, and the alcoholic solution evaporated, in order to separate the chloride of ammonium which is formed. A syrupy liquid was thus obtained, which was saturated at 100° Cent. with pure oxide of zinc and filtered. The filtered liquor gave, on cooling, a mass of beautiful prismatic crystals. These were recrystallised, heated in an oil-bath to 150° Cent., and analysed. The numbers obtained prove that the body in question was the lactate of zinc, as will be seen from the following table:

	Experiment.	Theory. $C_3H_5Zn'O_3$.
C	29·84	29·63
H	4·52	4·13
Zn	26·77	26·75

The following equation explains the formation of this acid:

$$C_2H_4O,HCN + HCl + 2(H_2O) = C_3H_6O_3 + NH_4Cl.$$

The insolubility of this salt in alcohol, its non-decomposition at 150° Cent. (sarcolactate gives off vapours at this temperature), and its crystalline form, sufficiently prove that it is the ordinary lactate of zinc, and not the sarcolactate.

The cyanhydrine of aldehyde is, then, isomeric, and not identical with the cyanhydrine of glycol of Wislicenus, seeing that it gives ordinary lactic acid with hydrochloric acid, and that it is converted into a resin by potash instead of giving sarcolactic acid. Moreover, the cyanides of the glycols have no disposition to evolve prussic acid and cannot be obtained in quantity and in a state of purity, whereas our body can be formed in any quantity and perfectly pure.

We have endeavoured to obtain the vapour density of this body by Dumas' method, but without success. On heating the balloon containing our body till 210°

* Communicated by the Authors.

in an oil-bath, and removing it from the bath, we observed that the aldehyde had been converted into a resin. On deducting its weight from the weight of the balloon the density of the vapour approached very near that of prussic acid. It appears to us, however, to be sufficiently proved that this compound only contains one molecule of each of the parent bodies, from the facts that it gives lactic acid with hydrochloric acid, and that it separates by the action of heat into prussic acid and ordinary aldehyde, and not into aldehyde or paraldehyde.

It appears to us that this is a very striking example of an organic body which is dissociated by heat and reconstructed by time.

EDITORIAL NOTES.

PLATING OR COATING METALS WITH METALS.

NOT very long ago, and quite in the remembrance of most who are likely to read this Journal, the principal manufactures that might have been described under the above title were the manufacture of tin plates, of tinned culinary utensils, and the operation of Sheffield plating. The process of "galvanising" (coating iron with zinc by immersion in the molten metal) has materially interfered with that of tinning, and the introduction of the principles of electro-deposition, to produce articles of beauty at a cheap rate, and to serve many useful purposes, has altered the condition of the Sheffield plating trade to such an extent that it only exists to produce certain articles of large consumption and well-defined form.

Great changes can also be traced in the theory and practice of electro-deposition itself. Smee, in his admirable work, laid down the "laws" of electro-metallurgy, as he was pleased to term them, in which the evolution of hydrogen during the time of deposition was made to determine the character of the deposit obtained; he also put forward certain views relating to the deposition of alloys in which the use of intense battery power was pointed out as a possible means of accomplishing that purpose. Now, it is found that, by the use of alkaline solutions, many deposits can be obtained in a reguline form during the evolution of hydrogen, and that, also, from certain alkaline solutions, brass and other alloys can be electro-deposited in a reguline form, without the use of more battery power than is necessary to compensate for the want of electric conduction in the solution employed.

In the five years that are comprised between the years 1861—1865, inclusive, the increase of knowledge (practical and theoretical) does not appear to have been very great in relation to the subject at the head of this paper. The chief attempts at improvement have been made in the practical details of the tin-plate manufacture. The use of ordinary rosin as a flux, above the molten metal, is provided for by special arrangements by Messrs. Banks and Morgan, in their patent specification;* Messrs. Morewood and Whytock† employ ordinary rosin, in conjunction with tallow, by using a plurality of coating baths worked in connection, by the aid of machinery. With a view to economy of material and of working, rollers, guides, and other machinery, are employed in certain inventions.‡ Some inventors set forth improvements in the fluxes used (independent of the above-mentioned rosin), comprising potassium, ammonium, zinc, tin, and cadmium chlorides.§ H. J. Madge‖ manufactures a cheap alloy for coating iron plates, by using lead and antimony, with, perhaps, a small quantity of tin, instead of tin alone. Messrs. Nurse¶ use an annealing pot with a double case. Lastly, George Tomkins** coats lead and terne plates by pouring the melted metal over the plate, and uses an alloy of nickel, zinc, and lead.

Electro-gilding has made but little practical progress during this time. The ordinary solution of gold trichloride in potassium cyanide is used by Martin Miller†† to gild wire, and by Kuhlmann‡‡ to ornament metal. The depositing solution employed by Moore§§ contains potassium ferrocyanide, "pearl potash," potassium iodide, sodium carbonate, copper cyanide, silver cyanide, and "fine gold;" it is said to give a rapid, durable, and richly coloured deposit. J. B. Thompson‖‖ prepares iron or steel articles for electro-deposition by tinning, and then pickling and washing them; he also ornaments silver surfaces by electro-gilding them with a polarised paint-brush, containing the electro-depositing solution.

In electro-silvering the following are the principal points that appear: Martin Miller¶¶ employs a solution of silver-chloride dissolved in potassium cyanide to coat wire. Moore*** uses electro-magnetic force, but does not state his silvering solution. Weil's solution for previously coppered articles††† is made by means

* No. 317 (A.D. 1861).

† No. 815 (A.D. 1862).

‡ Taylor and Price, No. 1774 (A.D. 1861); Morewood and Whytock, No. 815 (A.D. 1862); Morewood, No. 123 (A.D. 1863); Tomkins, No. 534 (A.D. 1863); Saunders and Piper, No. 738 (A.D. 1863); Morgan, No. 802 (A.D. 1863); Girard, No. 1639 (A.D. 1863); Leyshon, No. 1956 (A.D. 1864); Jenkins, No. 1081 (A.D. 1865); and Saunders and Piper, No. 1843 (A.D. 1865).

§ Morewood and Whytock, No. 815 (A.D. 1862); Morewood, No. 123 (A.D. 1863); Morgan, No. 802 (A.D. 1863); and Girard, No. 1639 (A.D. 1863).

‖ No. 919 (A.D. 1862).

¶ No. 2183 (A.D. 1862).

** No. 534 (A.D. 1863).

†† No. 2023 (A.D. 1861).

‡‡ No. 1981 (A.D. 1864).

§§ No. 2029 (A.D. 1864).

‖‖ No. 3095 (A.D. 1864).

¶¶ No. 2023 (A.D. 1861).

*** No. 2088 (A.D. 1863).

††† No. 497 (A.D. 1864).

of silver nitrate, hydric tartrate, ammonia, and potassium cyanide; this solution gives an adherent and either brilliant or dead coating.

All the solutions for electro-coppering are evidently intended to coat iron or other easily oxidable metals. Miller* uses a mixture of copper carbonate, potassium cyanide, and potassium or sodium carbonate, to coat wire; the alkaline portion of the solution is first boiled, and then the copper carbonate is added, the mixture being kept boiling until ammonia is freely given off. Walcott† charges a strong potassium-cyanide solution with copper by electrolysis. Weil's electro-coppering solution‡ is formed by adding a solution of cupric sulphate to a solution containing sodic potassium tartrate and sodium hydrate. Thompson§ deposits copper (on an article already electro-coated with iron) by means of a solution of hydrated cupric oxide in sodium hyposulphite.

Amongst the other inventions that may be mentioned are the following:—Marshall|| prevents the fracture of metals, owing to their crystallisation, by coating their bearings with soft metal, by running the molten metal on to the enclosed bearing. Le Chatelier¶ deposits aluminium by electrolysis of fused sodic aluminium chloride. Bennett** tins lead pipes, that are made by hydraulic pressure, by the overflow of the melted metal. Beslay†† electro-coats iron with tin preliminary to the final electro-coating. Holley‡‡ coats iron with aluminium, in the fire, by means of a frit that contains felspar, silex, china clay, and a potash clay, when an external vitreous coating is required. When only a coating of aluminium is wanted boracic trioxide is added to a potash clay; the slag throws itself off as the iron shrinks.

Owing to the trouble of arriving at the history of patented inventions prior to the year 1852, many important improvements have been repatented. This difficulty, however, has been much lessened by the printing of the specifications, superintended by Mr. Woodcroft, in his successful endeavour to carry out the amended patent laws. Lately, and more especially since the year 1857, his attempts have received great accession of strength by the publication of 'Abridgments of the Specifications,' in series chronologically arranged, and drawn up by competent men acquainted with the subject to which each series refers.

Notwithstanding this, the number of inventions still repatented may be drawn from the following analysis of those relating to our subject between the years 1861—1865 inclusive:

Rosin was used on the surface of melted metal as early as A.D. 1786.* Silvering glass with silver, which is afterwards electro-coated with copper, is referred to in the year 1852.† Apparently, the first patent in which machinery was used for tinning iron or steel plates was secured in 1852.‡ A solution of copper carbonate in potassium cyanide was used to electro-deposit copper in 1853.§ Although Smee|| sets forth the deposition of copper from its electro-solution in potassium-cyanide, it forms the subject of Walcott's patent.¶ Smee, in 1851,** and Alexander Watt, in 1860,†† electro deposit silver from a solution of its chloride in potassium cyanide.‡‡ Smee§§ points out the electro-deposition of gold from a solution of its chloride in potassium cyanide.|||| The combination of hydric tartrate, ammonia, and potassium cyanide, was used in 1857 to electro-deposit silver.¶¶

We have been much assisted in getting together the above particulars by a small book,*** lately printed by order of the Commissioners of Patents, brought out by Mr. Woodcroft, and compiled by Mr. W. H. Walenn. Besides an introduction (which contains information about the deposition of antimony, the use of weak electric currents, the deposition of thallium, and the reduction of metals by magnesium), this work is fully supplied with a supplement, a lucid preface, and two indexes. In the subject-matter index it is a novel feature to find the new nomenclature employed to identify chemical substances that would otherwise be cast upon the sea of uncertainty by the numerous synonyms employed by inventors and patent agents in their specifications.

* No. 2023 (A.D. 1861).
† No. 2784 (A.D. 1861).
‡ No. 497 (A.D. 1864).
§ No. 2592 (A.D. 1865).
|| No. 1055 (A.D. 1861).
¶ No. 1214 (A.D. 1861).
** No. 2213 (A.D. 1861).
†† No. 1896 (A.D. 1862).
‡‡ No. 1156 (A.D. 1863).

* Compare No. 1551 of the old patent law with No. 317 (A.D. 1861).
† Compare No. 1196 (A.D. 1852) with No. 619 (A.D. 1861).
‡ See No. 49 (A.D. 1852).
§ Compare No. 1836 (A.D. 1853) with No. 2023 (A.D. 1861).
|| See 'Elements of Electro-metallurgy,' by Alfred Smee, F.R.S., edition of 1851, p. 171 and p. 202.
¶ No. 2784 (A.D. 1861).
** See Smee's 'Electro-metallurgy,' p. 190.
†† See 'Electro-metallurgy Practically Treated,' p. 44.
‡‡ See No. 2023 (A.D. 1861).
§§ See Smee's 'Electro-metallurgy,' p. 183.
|||| See No. 2023 (A.D. 1861), also No. 1981 (A.D. 1864).
¶¶ Compare No. 1540 (A.D. 1857) with No. 497 (A.D. 1864).
*** 'Abridgments of Specifications relating to Plating or Coating Metals with Metals.' Part II. A.D. 1861—1865, 1867, pp. 74, price 10d.

ABSTRACTS OF FOREIGN PAPERS.

BY HENRY WATTS, B.A., F.R.S.,
AND E. J. MILLS, D.SC.

On some Derivatives of Cinnamic Acid. By Ch. Glaser.*

In a former memoir† the author has shown that phenyl-dibromopropionic acid, produced by the action of bromine on phenyl-acrylic (cinnamic) acid, may give rise, by its decomposition, to two isomeric monobromophenyl-propionic acids; also that phenyl-propionic (hydrocinnamic) acid, when subjected to the action of bromine, sometimes gives rise to products of substitution, sometimes reproduces phenyl-acrylic acid.

The experiments described in the present communication show that phenyl-acrylic (cinnamic) acid can also unite directly with hypochlorous and hypobromous acids. The addition-products, which may be designated by the names *phenyl-monochlorolactic* and *phenyl-monobromolactic acids*, are converted by inverse substitution into *phenyl-lactic acid*. Under the influence of hydracids they exchange the group HO for the halogen-element of the hydracid employed; phenyl-lactic acid thus giving rise to *phenyl-chloropropionic*, *phenyl-bromopropionic*, and *phenyl-iodopropionic acids*, and the substitution-products of phenyl-lactic acid giving rise to *phenyl-dichloropropionic*, *phenyl-dibromopropionic*, and *phenyl-chlorobromopropionic acids*. These same substitution-products, decomposed under other conditions, lose the elements of chlorhydric or bromhydric acid, and are transformed into *phenyl-pyruvic acid*.

The following are the formulæ of the bodies thus obtained:

$C_6H_5.CH_2.C =$	$.CO_2H$...	Phenyl-acrylic (cinnamic) acid.
$C_6H_5.CH_2.CHOCl$	$.CO_2H$...	Phenyl-chlorolactic acid.
$C_6H_5.CH_2.CHOBr$	$.CO_2H$...	Phenyl-ibromolactic acid.
$C_6H_5.CH_2.CCl_2$	$.CO_2H$...	Phenyl-dichloropropionic acid.
$C_6H_5.CH_2.CBr_2$	$.CO_2H$...	Phenyl-dibromopropionic acid.
$C_6H_5.CH_2.CClBr$	$.CO_2H$...	Phenyl-chlorobromopropionic acid.
$C_6H_5.CH_2.CHOH$	$.CO_2H$...	Phenyl-lactic acid.
$C_6H_5.CH_2.CHCl$	$.CO_2H$...	Phenyl-chloropropionic acid.
$C_6H_5.CH_2.CHBr$	$.CO_2H$...	Phenyl-bromopropionic acid.
$C_6H_5.CH_2.CHI$	$.CO_2H$...	Phenyl-iodopropionic acid.
$C_6H_5.CH_2.CO$	$.CO_2H$...	Phenyl-pyruvic acid.

Phenyl-chlorolactic acid, $C_9H_9ClO_3$.—Free cinnamic acid combines but slowly with hypochlorous acid. Better results are obtained by adding aqueous hypochlorous acid to a solution of sodium-cinnamate; but the best mode of preparation is to generate the hypochlorous acid in the solution itself, namely, by passing chlorine into a mixed solution of sodium-cinnamate and -carbonate:

$$2C_9H_7O_2Na + CO_3Na_2 + Cl_4 + H_2O = 2C_9H_8ClO_3Na + 2NaCl + CO_2.$$

Cinnamate. Phenyl-chlorolactate.

The resulting aqueous solution, freed from excess of hypochlorous acid by addition of sulphurous acid and from an oily product (probably chlorostyrol) which forms at the same time, by addition of chlorhydric acid, decantation, etc., is shaken up with ether, which dissolves out the phenyl-chlorolactic acid, and deposits it, on evaporation, in the crystalline state.

Phenyl-chlorolactic acid thus prepared is very soluble in cold water, still more in hot water, and crystallises from a hot solution, on cooling, in scales or very thin six-sided plates, which contain $C_9H_9ClO_3.H_2O$, give off their crystallisation-water over oil of vitriol at ordinary temperatures, and melt at 70°–80°. The acid dissolves in chloroform and crystallises therefrom in well-defined anhydrous prisms, which melt at 104°. It easily decomposes under the influence of various reagents. Its silver salt, $C_9H_8ClO_3Ag$, is a white precipitate, composed of microscopic prisms.

Phenyl-bromolactic acid, $C_9H_9BrO_3$.—This acid cannot be conveniently prepared in the same manner as the preceding, on account of the large quantity of oily bromostyrol which forms at the same time. It is more easily obtained by the action of boiling water on phenyl-dibromopropionic acid, $C_3H_3(C_6H_5)Br_2O_2$ (which is produced by direct addition of bromine to cinnamic acid). This acid, as observed by Erlenmeyer,* undergoes, when boiled with water, two kinds of decomposition, the smaller portion of it yielding monobromostyrol, bromhydric acid, and carbon-dioxide, while the larger portion exchanges 1 at. bromine for 1 at. HO, producing the acid $C_9H_9BrO_3$. The resulting aqueous solution, after being freed from oily products, deposits the acid on cooling in six-sided plates resembling phenyl-chlorolactic acid.

Phenyl-bromolactic acid is very soluble in hot water, also in alcohol and in ether, and separates from its ethereal solution by spontaneous evaporation in groups of small prisms irregularly crossed. It likewise dissolves in warm chloroform, and separates by cooling and evaporation in beautiful anhydrous prisms melting at 125°. The crystals deposited from the aqueous solution contain $2C_9H_9BrO_3.H_2O$, and melt some degrees lower. Both the acid and its salts are very unstable. The *silver-salt*, $C_9H_8BrO_3Ag$, is formed by adding dilute ammonia (not in excess) to an alcoholic solution of the acid mixed with silver-nitrate, and is deposited in very characteristic flattened needles. It is very unstable, being decomposed both by light and by a gentle heat.

Phenyl-dichloropropionic acid, $C_9H_8Cl_2O_2$.—This acid is formed by heating phenyl-chlorolactic acid to 40° or 50° with fuming chlorhydric acid—

$$C_9H_9ClO_3 + HCl = H_2O + C_9H_8Cl_2O_2.$$

The liquid left to itself in a closed vessel deposits the

* 'Bulletin de l'Académie Royale de Belgique' [2], xxiv, 14—48 (Août, 1867).

† Ibid., 3rd Nov., 1866.

* 'Zeitschrift fur Chemie,' 1864, p. 545.

new acid in small prismatic crystals. It is insoluble in water, and very unstable, being easily reconverted into phenyl-chlorolactic acid—this change taking place in a few days when fuming chlorhydric acid containing crystals of phenyl-dichloropropionic acid, is exposed to the air.

Phenyl-dibromopropionic acid, $C_9H_8Br_2O_2$, prepared like the preceding, crystallises in thin scales, identical with the product obtained by the direct addition of bromine to cinnamic acid. It melts at 195°, and, like the preceding, is easily reconverted into phenyl-bromolactic acid.

Phenyl-chlorobromopropionic acid, $C_9H_8ClBrO_2$.—This acid may be prepared either by the action of chlorhydric acid on phenyl-bromolactic acid, or of bromhydric acid on phenyl-chlorolactic acid:

$$C_9H_9ClO_3 + HBr = H_2O + C_9H_8ClBrO_2,$$
$$C_9H_9BrO_3 + HCl = H_2O + C_9H_8ClBrO_2.$$

The products of the two reactions are identical. The acid crystallises from benzol in rhomboidal scales, melts at 170°—180°, sublimes easily at 160°, and decomposes by prolonged heating to higher temperatures.

Fuming iodhydric acid does not act on phenyl-chlorolactic or phenyl-bromolactic acid; but on heating the liquid, iodine is set free, and an oily body is formed, which crystallises on cooling. The reaction probably takes place as shown by the following equations:

$$C_9H_9ClO_3 + HI = C_9H_8ClIO_2 + H_2O,$$
$$C_9H_8ClIO_2 + HI = C_9H_9ClO_2 + I_2.$$

Phenyl-lactic acid, $C_9H_{10}O_3$.—This acid is produced from its chlorinated or brominated derivative by the action of sodium-amalgam. When purified by repeated crystallisation from water—or, better, by converting it into a barium-salt, decomposing this salt with sulphuric acid, agitating the filtered solution with ether, and leaving the ethereal solution to evaporate,—it forms perfectly white irregular masses, consisting of extremely fine and brittle needles. It melts at 93°—94°, dissolves very easily in alcohol and ether, in all proportions of boiling water, and is moderately soluble in cold water. The crystals are anhydrous. The acid cannot be volatilised without decomposition. When heated to 180° it is resolved into cinnamic acid and water, $C_9H_{10}O_3 = C_9H_8O_2 + H_2O$, and if it be heated rapidly to a higher temperature styrol is formed at the same time, constituting, indeed, the chief product—

$$C_9H_{10}O_3 = C_8H_8 + H_2O + CO_2.$$

Phenyl-lactate of potassium, $C_9H_9O_3K$, is obtained by neutralisation and evaporation, as a crystalline, slightly deliquescent mass. The *barium-salt*, $(C_9H_9O_3)_2Ba$, separates from a solution slowly evaporated over oil of vitriol, in hemispherical groups of well-defined prisms, and by cooling from a hot saturated solution, as a crystalline powder, apparently containing water of crystallisation. The *silver-salt* is deposited, on cooling, from a hot and moderately dilute solution of the potassium-salt mixed with silver-nitrate, in shining scales. A solution of potassium phenyl-lactate also gives, with *lead acetate* in dilute solutions, a white flocculent precipitate, with *ferric chloride* a yellowish precipitate, and with *cupric sulphate* a bluish precipitate.

Phenyl-lactic acid treated with hydracids easily gives up 1 at. HO for the halogen element of the hydracid, producing substitution-derivatives of phenyl-propionic acid. The products may be purified by washing with cold water, solution in alcohol, and gradual precipitation with cold water.

Phenyl-chloropropionic acid, $C_9H_9ClO_2$, crystallises in perfectly white shining scales at 126°, and decomposes at a somewhat higher temperature, giving off chlorhydric acid and leaving cinnamic acid. The same decomposition takes place still more readily under the influence of alcoholic potash.

Phenyl-bromopropionic acid, $C_9H_9BrO_2$, is obtained by precipitation with water from its alcoholic solution, as a light powder composed of small scales. It is more unstable than the preceding compound, being resolved at 130°, and also by boiling with alkaline water, into bromhydric and cinnamic acids.

Phenyl-iodopropionic acid, $C_9H_9IO_2$, prepared like the chlorinated acid, forms small curved needles without lustre. It is still more unstable than either of the two preceding acids, being decomposed at 120°, with liberation of iodine. With alcoholic potash it easily yields cinnamic acid, while a large quantity of styrol remains in the aqueous solution.

Popoff has shown* that cinnamic acid heated with fuming iodhydric acid yields hydrocinnamic (phenyl-propionic) acid. It is probable that phenyl-iodopropionic acid is first formed, but immediately converted into phenyl-propionic acid, with liberation of iodine, as shown by the following equations:

$$C_9H_8O_2 + HI = C_9H_9IO_2,$$
$$C_9H_9IO_2 + HI = C_9H_{10}O_2 + I_2.$$

Phenyl-pyruvic acid, $C_9H_8O_3 = C_3H_3(C_6H_5)O_3$, is produced by the action of alcoholic potash on phenyl-chlorolactic or phenyl-bromolactic acid, $C_9H_9ClO_3 - HCl = C_9H_8O_3$. On agitating the mixture a precipitate is formed, consisting of potassium-chloride and phenyl-pyruvate. The latter may be dissolved out by boiling alcohol, and crystallises on cooling in white shining scales containing $C_9H_7O_3K$.

A concentrated solution of this potassium-salt treated with a strong acid yields phenyl-pyruvic acid, in the form of oily drops, which immediately begin to decompose, throwing off carbon-dioxide. At a winter temperature these drops solidify to nacreous scales, which, if quickly taken out and pressed, may be preserved for some hours without sensible alteration. The acid, distilled with water, gives off an oil which has a pungent aromatic odour, and unites easily with acid sodium-sulphite, giving off carbon-dioxide at the same time. This oil is probably the aldehyde of toluylic acid, formed according to the equation—

$$C_9H_8O_3 = C_8H_8O_2 + CO_2.$$

Phenyl-pyruvate of potassium is very soluble in hot water, but the solution gradually decomposes, yielding carbonate of potassium, and a resin, which is probably a polymer of toluylic aldehyde. The

* 'Zeit. Chem.' (1865), 111.

sodium-salt, $C_9H_7O_3Na$, prepared by saturation, crystallises from alcohol in tufts of flattened needles. It is much less soluble in alcohol than the potassium-salt. The *silver-salt*, $C_9H_7O_3Ag$., prepared by precipitating the potassium-salt with silver-nitrate, or directly by decomposing phenyl-chlorolactate of ammonium with silver-nitrate, crystallises from water as a white powder formed of microscopic six-sided scales. It is easily decomposed under the influence of light or heat.

Ethyl-phenyl-pyruvate, $C_9H_7O_3.C_2H_5$, prepared by decomposing the silver-salt with ethyl-iodide, is an oily liquid having an agreeable fruity odour. It is decomposed by boiling with baryta-water, yielding carbonate of barium—partially, also, by distillation.

On the constitution and mutual relations of the preceding acids.—The remarkable fact that phenyl-chlorolactic acid treated with bromhydric acid, and phenyl-bromolactic acid treated with bromhydric acid, yield one and the same phenyl-chlorobromolactic acid, is of great importance in a theoretical point of view. To explain this and other reactions of cinnamic acid and its derivatives, the author represents cinnamic acid as a body having gaps or unsatisfied affinities, and supposes, moreover, that these unsatisfied affinities belong to a single atom of carbon, namely, that which is directly attached to the carbonyl-group. Erlenmeyer, on the other hand, does not admit any unsatisfied affinities in cinnamic acid, but supposes that two of its carbon-atoms are united by two affinities belonging to each of the carbon-atoms. These two modes of viewing the constitution of this acid may be represented as follows:

(Glaser.)	(Erlenmeyer.)
C_6H_5	C_6H_5
|	|
CH_2	CH
|	‖
$C =$	CH
|	|
CO_2H	CO_2H

The reactions which end in the production of phenyl-chlorobromopropionic acid may be represented, according to Glaser's view, by the following formulæ:

Cinnamic acid	$C_6H_5.CH_2.C =\ \ CO_2H.$
Phenyl-chlorolactic acid	$C_6H_5.CH_2.CClOH\ .CO_2H.$
Phenyl-chlorobromopropionic acid	$C_6H_5.CH_2.CClBr\ \ .CO_2H.$
And—	
Phenyl-bromolactic acid	$C_6H_5.CH_2.CBrOH\ .Cl_2H.$
Phenyl-chlorobromopropionic acid	$C_6H_5.CH_2.CBrCl\ \ .Cl_2H.$

Here it appears that the chlorine and bromine belong to the same atom of carbon, and cannot produce isomery when they unite with the cinnamic acid to form phenyl-chlorobromopropionic acid.

The same series of reactions, represented according to Erlenmeyer's formulæ, are as follows:

Cinnamic acid	$C_6H_5.CH =\ \ CH.CO_2H.$
Phenyl-chlorolactic acid	$C_6H_5.CHCl.CHOH.CO_2H.$
Phenyl-chlorobromolactic acid	$C_6H_5.CHCl.CHBr.CO_2H.$
And—	
Phenyl-bromolactic acid	$C_6H_5.CHBr.CHOH.CO_2H.$
Phenyl-chlorobromolactic acid	$C_6H_5.CHBr.CHCl.CO_2H.$

Here the bromine and chlorine are united to different atoms of carbon, and occupy different positions; the two acids thus formed should, therefore, be isomeric, and not identical, as experiment shows them to be. Moreover, according to Erlenmeyer's theory, there should be two normal phenyl-lactic acids, namely—

$$C_6H_5.CH_2\ \ .CHOH.CO_2H,$$
$$C_6H_5.CHOH\ .CH_2\ \ .CO_2H.$$

But the author's experiments show that phenyl-chlorolactic and phenyl-bromolactic acids yield the same normal acid.

From all these facts the author infers that the two unsatisfied affinities which come into play in the numerous reactions of cinnamic acid belong to the same atom of carbon. It still remains, however, to decide to which of the two carbon-atoms in the lateral chain of the molecule these unsatisfied affinities are to be attributed. This question the author hopes to solve by future experiments.

Professor Kekulé, in reporting upon M. Glaser's paper to the Belgian Academy of Sciences, observes that the author's hypothesis respecting the constitution of cinnamic acid affords a simple and elegant explanation of the facts detailed in the paper. Nevertheless, he is inclined to doubt whether this hypothesis can be regarded as affording the true expression of the constitution of cinnamic acid; inasmuch as, though perfectly satisfactory when viewed in connection only with the facts above detailed, it does not apply with equal facility to certain reactions described by M. Glaser in his former memoir; thus it does not explain how phenyl-dibromopropionic acid can give rise to two isomeric phenyl-monobromacrylic acids, and still less that these two acids, in uniting with bromine, can produce two isomeric modifications of phenyl-tribromopropionic acid.

On Albumen and its Decomposition by Potash. By R. Theile.*

Albumen containing only a small amount of mineral constituents was prepared in the following way:— The white of sixteen eggs was dissolved in a large volume of water, filtered as soon as it had become clear, and the filtrate mixed with alcohol as long as a precipitate continued to form. After long standing the alcoholic liquid was replaced by ether, with which the albumen was long agitated, and from which it was finally filtered. The last traces of ether were removed at 40°—50° by a current of dry air. After fourteen days' repose over calcic chloride the albumen became hard, brittle, and transparent; it weighed twenty grammes.

* 'Chem. Centralb.,' N.F. 1867, 296.

Analysis of the substance thus prepared led to the ·mula—

$$C_{74}H_{124}N_{17}SO$$

· the organic part, an expression which closely proximates to that of Lieberkühn—

$$C_{74}H_{112}N_{18}SO_{22}.$$

hen pure albumen is gradually heated it loses a oportion of water at 100°, and another at 130°; ese are in excess of the formula above given.

In order to ascertain the nature of the action of tash on albumen, some vitellin (which may be garded as a mixture of albumen and casein) was bmitted to experiment. 43·57 grammes vitellin, grammes potassic hydrate, and 250 c.c. water, were ixed together, and allowed to stand for three eeks at a mean temperature of 50°. The brown-red quid, which smelled weakly of ammonia, was filtered rough asbestos and boiled; it then evolved 0·212 amme ammonia, but no potassic sulphide was rmed. On adding hydric sulphate until the point exact neutrality was reached, the liquid changed yellow and green, emitted an offensive odour, and olved abundance of carbonic dioxide. Dilution used the return of the yellow colour and the prepitation of 0·039 gramme of a flocky substance. he filtrate was evaporated to dryness at 100° and e dry residue pulverised; ether extracted from it me fatty bodies of very penetrating smell. The ass was then treated successively with absolute cohol, with alcohol of 80, and alcohol of 60 per ent. The last-named solvent left behind nothing ut potassic sulphate. The alcoholic solutions conined leucine, tyrosine, and two brown extractke bodies of different solubility.

The flocky substance which was precipitated on eutralisation and dilution of the original filtered quid had the following composition :*

Carbon	66·31
Hydrogen	10·66
Nitrogen	6·17
Sulphur	0·72
Oxygen	16·14
	100·00

which is evidently that of some ill-defined product of partial decomposition. One of the brown substances was partly soluble in absolute alcohol and completely oluble in alcohol of 90 per cent. It is crystalline nd, in the anhydrous condition, milk-white; but a ery brief exposure to air converts it into an morphous glutinous mass. Analysis leads to the ormula $C_8H_{18}N_2O_7$. The aqueous solution is acid, nd produces a white precipitate with argentic itrate, mercuric nitrate, polyplumbic acetate, baric nd sodic hydrate, but a yellow precipitate with latinic chloride. Dry vitellin yields about 13 per ent. of the new body.

The second brown substance is insoluble in absolute lcohol or alcohol of 90 per cent. In its composition t approaches the formula $C_4H_9NO_2$, which is that of a homologue of glycocoll. Mercuric nitrate gives with its aqueous solution a voluminous precipitate, which, according to a single mercury determination, is probably $2C_4H_9NO_2 + Hg(NO_3)_2$. Both of the brown bodies are chemically very analogous to glycocoll or alanine.

* After deduction of ash and water.

On Toluol-sulphurous Acid. *By* R. Otto *and* Oscar von Gruber.*

Toluol-sulphurous acid is prepared in the same manner as benzol-sulphurous acid, namely, by the action of sodium-amalgam on sulpho-toluylic chloride in presence of dry ether or benzol—

$$C_7H_7ClSO_2 + Na_2 = C_7H_7NaSO_2 + NaCl,$$

the sodic being converted into the hydric salt by the action of hydric chloride. The acid is purified by recrystallisation from water, from which it separates in long needles, having the lustre of satin. It fuses at 85°, and decomposes if heated beyond 100°.

Toluol-sulphurous acid remains unaltered in an atmosphere of dry oxygen, but in presence of moisture oxygen is rapidly absorbed, with formation of toluol-sulphuric acid, fusing at 104°—105°.

The toluol-sulphites are, for the most part, easily soluble in alcohol and hot water; they are obtained by neutralising the aqueous solution of the acid with an oxide, or the corresponding carbonate. The calcic salt, $(C_7H_7SO_2)_2Ca + 4H_2O$, crystallises in small white needles. The basic salt is anhydrous, highly electrical, and floats upon water like stearic acid. The argentic salt is a heavy white precipitate, crystallising from a large volume of water in white iridescent needles. The solution of the sodic salt furnishes a precipitate with plumbic and polyplumbic acetate, zinc sulphate, stannous chloride, mercurous nitrate, ferrous sulphate, and ferric chloride, and also with cupric sulphate.

If the acid be dissolved in hot alcohol containing hydric chloride the ethylic ether is soon formed; it may be precipitated by water. Ethylic toluol-sulphite is an oily body, of fruity smell, soluble in ether in all proportions, and not to be distilled without decomposition.

Bromine acts readily on toluol-sulphurous acid suspended in water, replacing one eighth of the hydrogen of the acid, and so forming toluol-sulphuric bromide, $C_7H_7SO_2Br$. The new bromide is insoluble in water, but dissolves in alcohol, ether, and benzol; its crystalline form closely resembles that of calcite, and it melts between 95° and 96°. That this substance is really a bromide, and not a brominised acid, is shown by its deportment with strong aqueous ammonia, with which it furnishes sulphotoluolamide ($C_7H_7SO_2.H_2N$) and hydric bromide. Sulphotoluolamide is pretty easily soluble in hot alcohol or hot water, and fuses at 139°—140°, in accordance with Jaworsky's observation.† The bromide, moreover, yields ethylic toluol-sulphate with warm absolute

* 'Ann. Ch. Pharm.,' cxlii, 93.
† 'Zeit. Chem.,' N.F., I, 222.

alcohol, and potassic toluol-sulphate with potassic hydrate. These facts lead to the conclusion that toluol-sulphurous acid should rather be regarded as a hydride than an acid. Chlorine reproduces the original chloride.

Toluol-sulphuric hydride, if placed in contact with zinc and dilute hydric sulphate, produces, as Märker* first observed, hydro-metabenzylic sulphide, a substance which is volatile with the vapour of water, and fuses at 42°—43°. The reaction may be expressed by the equation—

$$\left.\begin{matrix} C_7H_7 \\ SO \\ H \end{matrix}\right\} O + 2H_2 = 2H_2O + \left.\begin{matrix} C_7H_7 \\ H \end{matrix}\right\} S$$

and toluol-sulphuric hydride may be represented as standing midway between toluol-sulphuric chloride and hydro-metabenzylic sulphide:

$$(1) \quad C_7H_7SO_2.Cl + H_2 = C_7H_7SO_2.H + HCl;$$

$$(2) \quad C_7H_7SO_2.H + 2H_2 = C_7H_7S.H + 2H_2O.$$

A Simple Process for Preparing Crystalline Chromic Oxide. By R. Otto.†

Dry and powdered potassic dichromate is placed in a tube of difficultly fusible glass, and heated gently in a slow stream of dry hydrogen. Vapour of water is soon seen to emerge from the tube, and the reduction is complete in a short time.

$$2K_2Cr_2O_7 + 3H_2 = 2K_2CrO_4 + 3H_2O + Cr_2O_3.$$

After cooling, the dry mass admits of easy removal from the tube; water dissolves potassic chromate and leaves behind magnificent spangles of chromic oxide, having the lustre of the wings of the golden beetle. Otto thinks that the medium in which crystallisation takes place is potassic chromate, chromic acid first being liberated and then reduced. A special experiment has convinced him that *without* the alkaline salt only an amorphous product is obtained.

On Argentous and Argentic Hydrate. By C. Weltzien.‡

If a plate of polished silver be placed in a perfectly neutral solution of hydric peroxide bubbles of oxygen soon cover the surface of the metal, which is gradually dissolved as argentosum. A grey-white deposit is formed on the plate, and a blue-grey precipitate makes its appearance in small quantity.

If the solution be left in contact with air it slowly acquires a brownish-red colour, and a little silver is precipitated. If evaporated, a colourless crystalline mass is obtained, which, on treatment with water, leaves silver behind. The solution now contains argentic hydrate, has a weak alkaline reaction, and gives argentic chloride with hydric chloride. A solution of argentous hydrate gives a precipitate of argentic chloride and silver with hydric chloride, but no precipitate with hydric sulphide. The formation of argentous hydrate and its decomposition on evaporation are shown in the equations—

$$(1) \quad 2Ag_2 + H_2O_2 = 2H(Ag_2)O;$$

$$(2) \quad 2H(Ag_2)O = 2HAgO + Ag_2.$$

On the Preparation of the Fatty Alcohols from their Primary Members. By A. Siersch.*

The author is engaged in a series of researches on this subject, and has now published the first results of his experiments. In these he has endeavoured to transform ethylic alcohol into hydric propionate, hydric propionate into propionic aldehyde, and this last into the corresponding alcohol.

Ethylic cyanide was prepared in accordance with Williamson's directions,† and converted into calcic propionate, the weight of which was 300 grammes. The proper amount of calcic formiate was then added and the whole distilled, in successive small portions, in a glass retort. 170 grammes of liquid were obtained, one third of whose volume consisted of a light oily body smelling of œnanthol; the rest was chiefly water. The oily body was repeatedly treated with a strong solution of monosodic sulphite, and the portion insoluble in that liquid, after drying with potassic carbonate, was separately distilled; the distillate weighed 30 grammes. By repeated fractionation it was divided into four portions, boiling at 40°—90°, 90°—96°, 96°—99°, 100°—101°. The last two agreed in giving with sodium-amalgam substances of the nature of alcohols, which could be converted into iodides; but the last was the only one of the fractions which in its composition corresponded to a definite formula—that of propione.

The compounds which had dissolved in the solution of monosodic sulphite were liberated by potassic hydrate, dried by means of the carbonate, and distilled. 30 grammes of distillate were obtained and redistilled several times. Nine fractions were thus procured, whose boiling-points ranged from 55° to 200°; one of them yielded results on analysis which corresponded with the formula of diethylacetone; moreover, it agreed in its boiling-point (137°—139°) with that substance as prepared by Frankland (who gives the temperature 137·5°—139°). The author remarks, in conclusion, "This much may be safely asserted, that propionic aldehyde cannot be prepared in this way, and that the process for transforming fatty acids into their aldehydes, which Piria discovered and Limpricht termed a 'class-reaction,' is by no means universal, for, even with the third member of the series, propionic acid, instead of the aldehyde, only isomeric or allied bodies are obtained."

Michaelson has already shown‡ that a mixture of calcic butyrate and formate gives a very complicated result on distillation.

* 'Ann. Ch. Pharm.,' cxxxvi, 95.
† 'Ann. Ch. Pharm.,' cxlii, 102.
‡ 'Ann. Ch. Pharm.,' cxlii, 105.

* 'Ann. Ch. Pharm.,' cxlii, 115.
† 'Jahresb. f. Chemie,' 1853, 499.
‡ 'Ann. Ch. Pharm.,' cxxxiii, 182.

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